The Electrical Industry's Weekly Magazine

March 6, 1961

Electrical World

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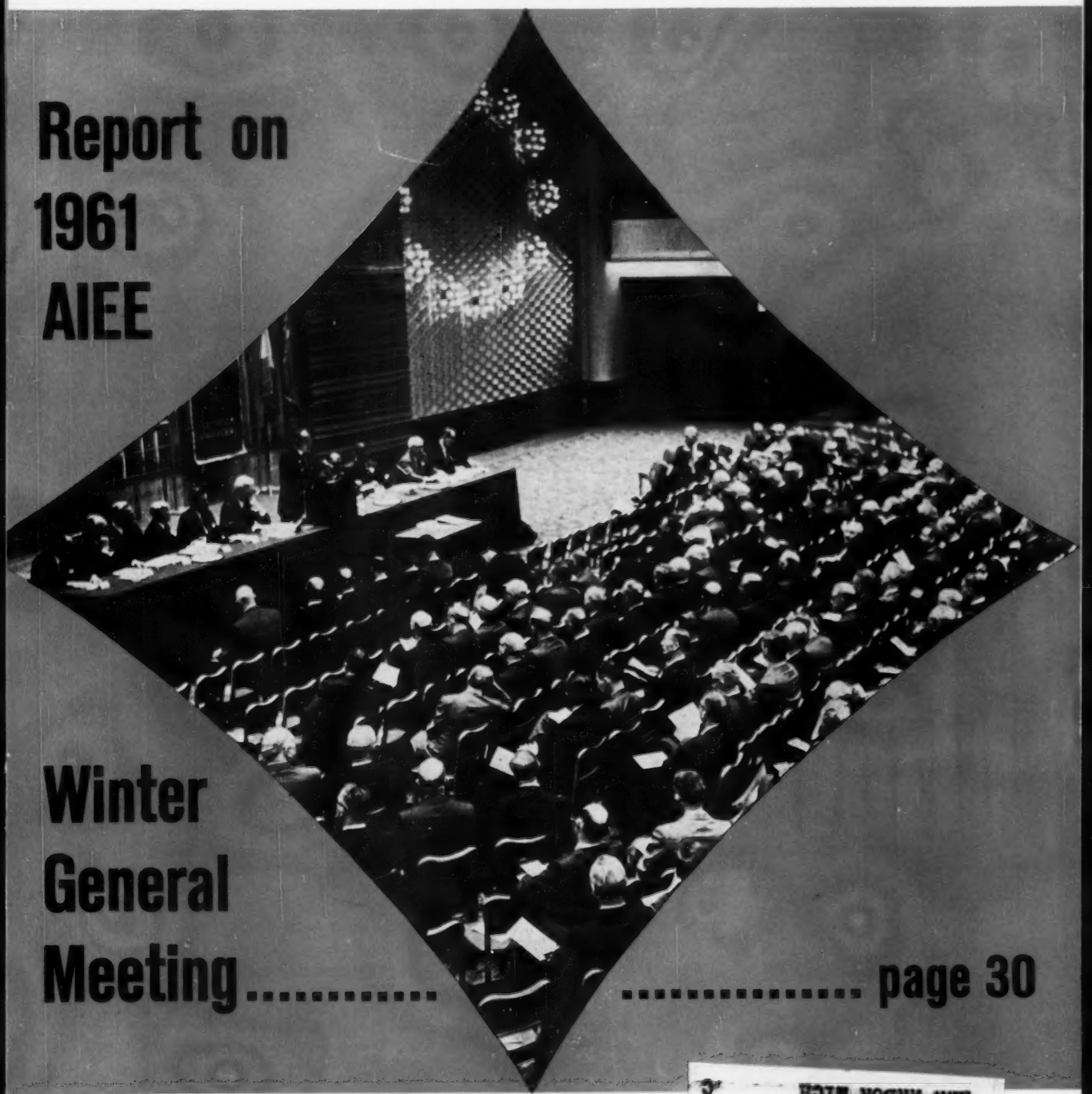

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Winter General Meeting

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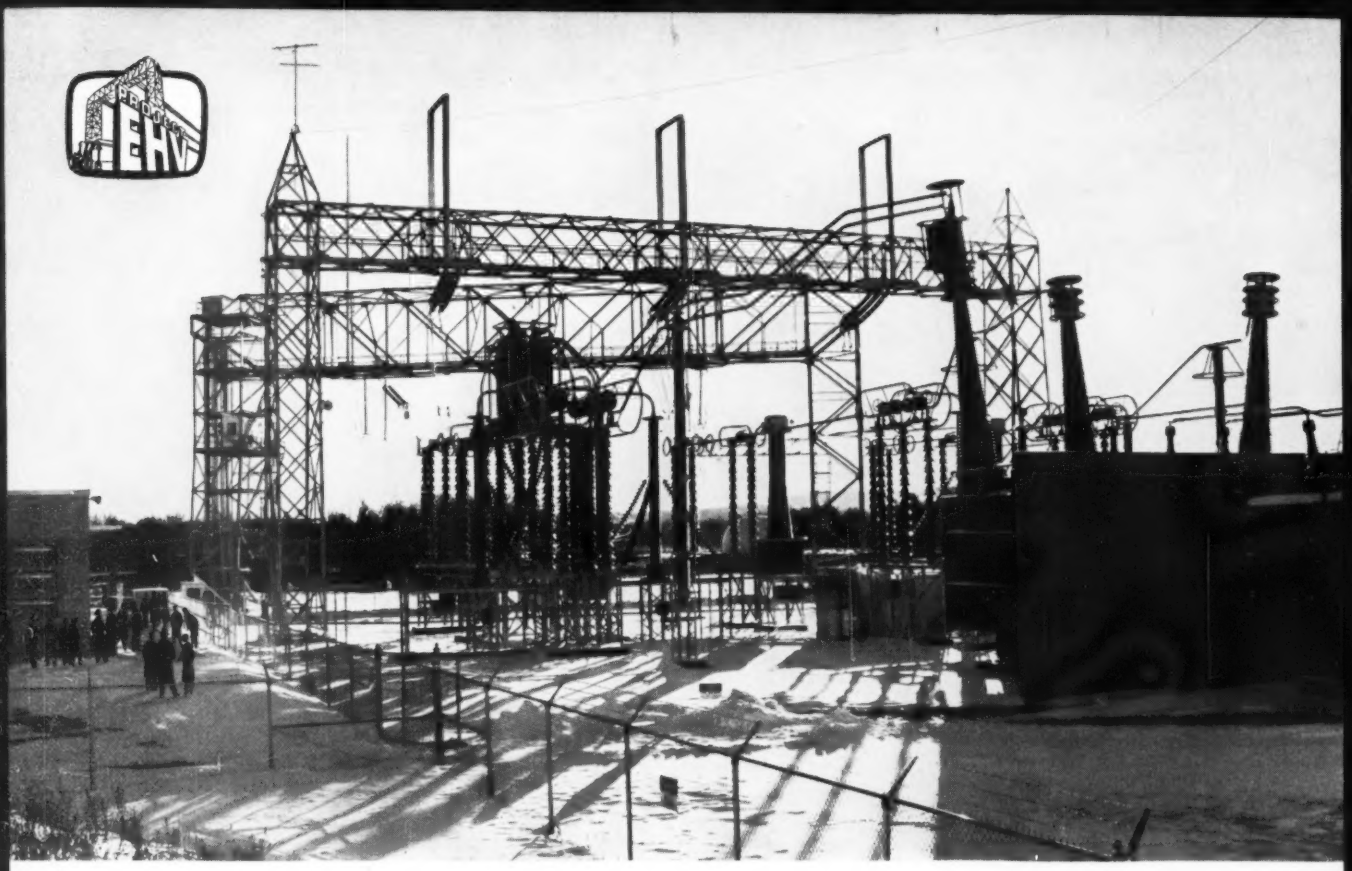
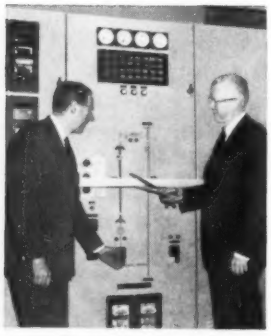


PROJECT EHV IS ENERGIZED

Super-voltage Research Will Help Solve Transmission Problems



H. J. Cadwell, President of Western Massachusetts Electric Company, energizes Project EHV as R. L. Gibson, Vice President of G.E., cuts ribbon.

720,000 VOLTS, the highest voltage ever attained on a transmission line, were recorded on December 8, 1960, during energizing ceremonies at the north section of Project EHV, a giant outdoor laboratory located near Pittsfield, Massachusetts. The objective for the 4.3-mile, prototype extra-high-voltage power system: to increase knowledge of EHV transmission, thus helping electric utilities to satisfy efficiently and economically the nation's soaring demand for electricity.

ADVANCED EQUIPMENT at the $7½-million Project includes a 650-kv, 40-mva power transformer, four 650-kv disconnect switches, and eighteen towers of four materials and nine designs. More than 260 instruments are now recording or being installed to record electrical, meteorological, and mechanical data (10 million readings annually) for computer processing.

TESTING will be conducted at 460 to 500 kv until mid-1961 and at 650 to 750 kv after that. In late 1962 the line will be integrated with the adjoining Western Massachusetts Electric Company system to obtain operating experience as well as further test data.

ELEVEN COMPANIES* have joined General Electric to build this system. Two advisory groups, one composed of executives of fifteen American and Canadian utilities and the other of fourteen consulting engineers, are taking an active part in guiding research. Project EHV is an outstanding example of co-operation by utilities, consultants, and manufacturers to help solve load growth problems.

604-04

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Electrical World

MARCH 6, 1961
Vol. 155, No. 10

What in the Electrical World . . .

In the Sept. 26, 1960, issue of *Electrical World,* we presented you with a number of changes in format, which, in the words of the first "What in the World" column, were "designed to give you a better, fresher publication . . ."

Prior to that date, you may recall, a table of contents was located here on p 3, right where you're reading now. One of the changes relocated the contents listing to the first yellow page of the magazine (p 11, this issue), where it now includes brief discussions of most of the coverage, and is called "Preview of the Issue."

At the time, we were much concerned lest you might be inconvenienced at not having a contents listing right inside the front cover (although many magazines don't). Actually, we had mechanical problems which virtually dictated the new location. And we did feel that the first yellow page can be found quickly; we hoped that you would develop the habit easily of checking for the "Preview" in its new location.

We haven't had a recent chance to use "readership research" to get a numerical estimate as to how you're making out in this regard. Our field editors, however, have probed readers on their regular plant and office visits, and have told us that, with some (usually vociferous) exceptions, you've had little trouble finding the contents listing.

We'd be much interested in notes from you if you disagree strongly.

Chuck Hochgesang

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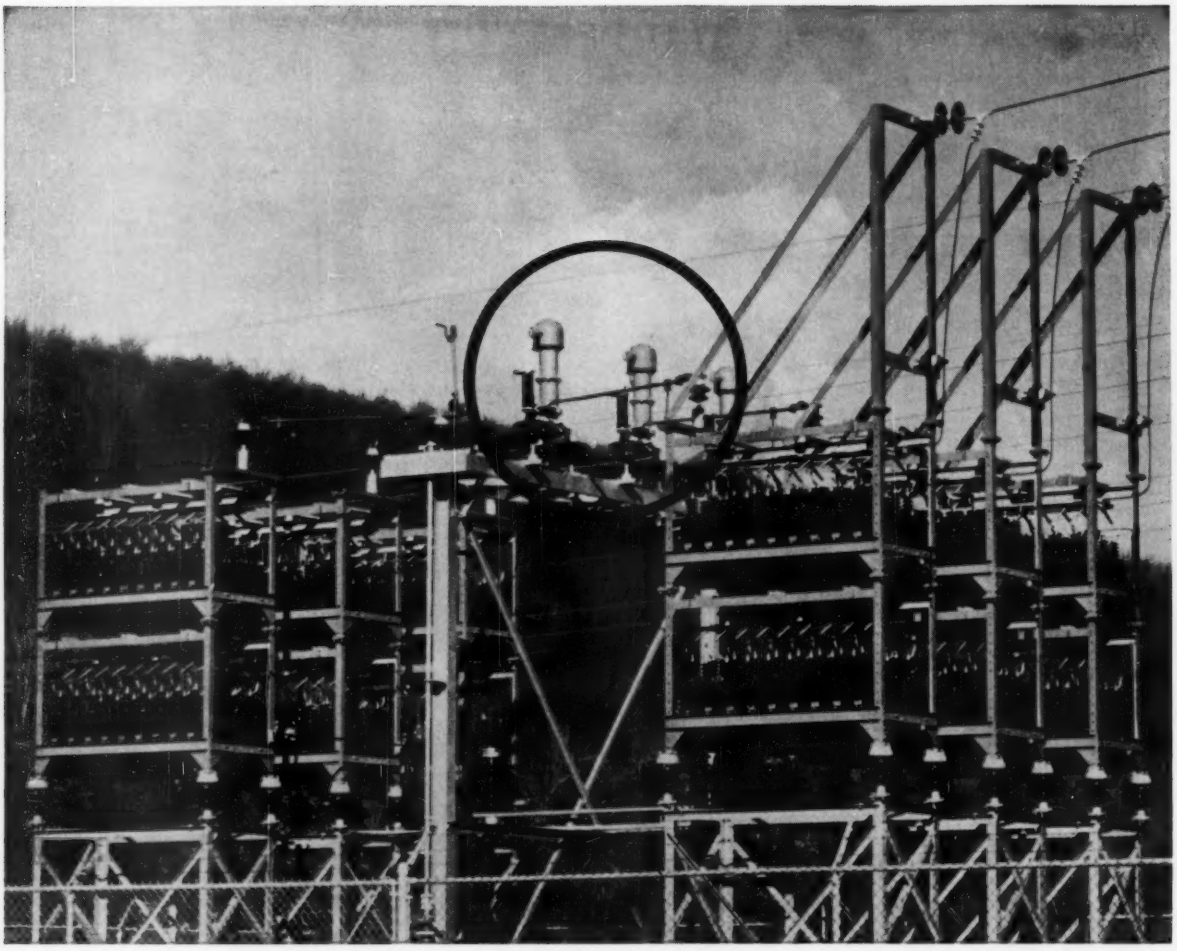
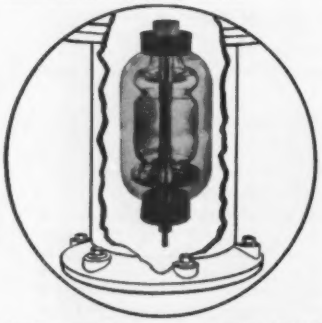


VACUUM SWITCHES PICKED BY PENELEC TO SWITCH HIGH VOLTAGE BANK-TO-BANK CAPACITORS

The switchgear controlling these capacitors are new Hi Voltage-Joslyn 34.5 kv Heavy Duty Vac-Rupter® switches utilizing Jennings vacuum power switches as the interrupting element.



Jennings type R9G vacuum power switch for 34.5 kv load break duty, 250 amp rated thermal currrent. Maximum fault interruption rating is 2000 amps rms.

Alert to the consumers' need for steady, uninterrupted electrical service, PENELEC chose vacuum switches to switch these two 5400 KVAR, 23 kv capacitor banks. Jennings vacuum switches are ideally suited to this type of service because they interrupt capacitive loads at the first current zero and recover dielectric strength fast enough that no restrikes occur. These characteristics are inherent in vacuum switches because of the very fast deionization of the contact gap during and immediately after interruption. Vacuum contacts in this type of service require no maintenance over an operating life of ten years or more.

This particular installation is only one of hundreds of successful power installations using Jennings vacuum switches since Jennings pioneered their use over six years ago. And behind that first commercial power application in 1955 was seven years of research, development, and the experience gleaned from hundreds of lighter duty industrial vacuum switch applications in constant use in the field.

Jennings vacuum switches have proven equally as effective in load break switching, transformer magnetizing current and inductive switching, fault current interruption, and high voltage transmission line dropping.

Our distribution of vacuum switches is through switchgear manufacturers who design and build complete switchgear equipment utilizing Jennings vacuum switches.

More detailed information on our 10 sizes of power switches is available on request

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Electrical World

Letters

Not the First Glass Furnace

To the Editor:

You printed a short article on all-electric Glass Furnaces on page 66 of your issue of 9 January, 1961, in which our name was used. We thank you for the article in general, but it has a claim which is not correct. The furnace which we are designing for Chattanooga Glass Co will not be the first all-electric glass bottle furnace in the US. One all-electric glass bottle furnace was built at Northwestern Glass Co in Seattle in 1944. It was of commercial size, producing approximately 25 tons of glass per day. Northwestern built a duplicate of that furnace in 1949, and both furnaces are still operating. In the last few years, these furnaces have been modified to increase output by means of burning fuel, but more than half of their output is still melted electrically.

Further, about four or five years ago Owens-Illinois Glass Co operated an all-electric furnace in Los Angeles for about one and a half years.

Your comments about the relative efficiency of gas-firing (25%) vs. all-electric melting (80%) are substantially correct, but it should be pointed out that the glass manufacturer is interested in the total cost of melting, not just in the relative efficiencies of fuels. Many factors enter into the decision as to whether to use electric melting vs. gas melting, as follows:

1. Basic cost of the available fuels vs. electric power.
2. Relative efficiency of use of the fuel vs. electric power.
3. If the glass has a volatile component such as cadmium, boric oxide, fluoride, etc., electric melting can be used to conserve such components.
4. Electric melting works very well in melting very dark-colored glasses.
5. The repair cost for all-electric furnaces is less than fuel-fired furnaces.
6. The space required for all-electric furnaces is usually less than for fuel-fired furnaces.

Lawrence Penberthy
Penberthy Electromelt Co

Dateline . . .

Dallas—What's happened to the fire and the evangelical zeal that used to characterize the annual National Rural Electric Cooperative Assn convention? An observer at the Dallas meeting last month, after missing the past nine conventions, was struck by the tameness, the subdued tone, the changes that have crept into the co-op convention atmosphere.

If the observer had turned off his hearing aid and depended only on watching the gestures of the speakers, seeing the slides on the giant screen, and reading the topics on the thick, printed program, he might have almost mistaken the Dallas meeting for a meeting of the Edison Electric Institute. Even with the hearing aid working, there was a striking similarity.

A lot of things have changed, and one should not overlook the possibility that the most trained observer changes, too. But the old excitement and the sense of expectancy was missing from the meeting.

The once-temperamental and bombastic ringmaster, Clyde Ellis, general manager of NRECA, appeared to have traded in his old-time orator's license for a new, sincere look and a superbly controlled speech delivery. His once-rumpled fringe of hair is now smoothed down and his clothes are neatly tailored to give him an urbane look. His once-harried expression is now well composed and he wears an easy smile. He could easily be mistaken for a power company executive or a career diplomat.

Even more striking than his changes in appearance was his platform manner. While there were firmness and conviction in his voice, there was a practiced restraint in his phrases and his delivery. A past master of evangelical fervor, Ellis could pace a speech to keep his audience on the edge of their chairs, or bring them to a rising ovation, or touch

(*Continued on page* 29)

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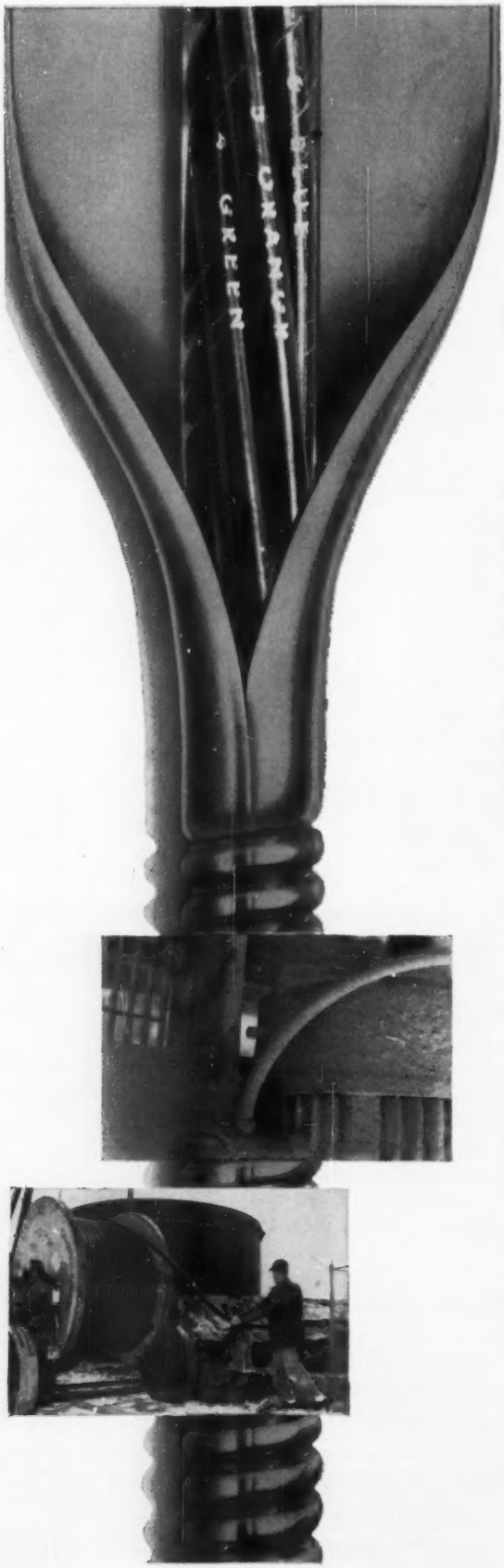

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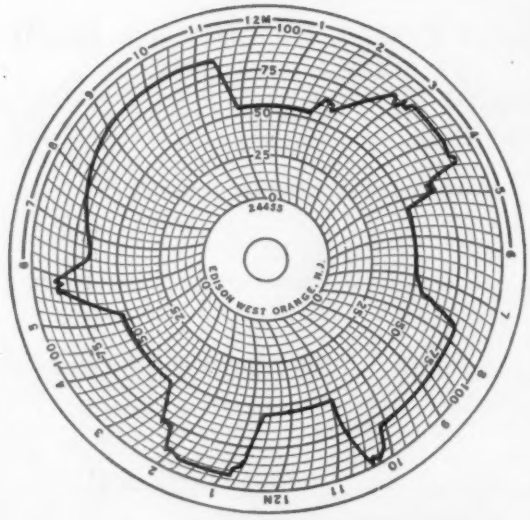

Stylus operates through this slot. The measuring system is sealed off from any careless tampering.

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MARCH 6, 1961
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NEXT WEEK

SAVINGS AND RELIABILITY result from computer control of Sterlington power plant.

LATE NEWS ▶ **Freak storm tears down power lines in Ohio** leaving more than 70,000 customers without service. Snow and freezing rain coupled with 50-mph winds bring down lines and short out transformers in Cleveland Electric Illuminating and Ohio Edison territories. CEI switchboard averages three incoming calls a second as customers are left without light, heat, and refrigeration. Crews supplemented by linemen rushed into the area from Canton, Toledo, and Erie work round the clock restoring service. CEI calls the storm, which caused more than $250,000 in damages, the worst in its history.

Senate confirmation of Joseph C. Swidler, President Kennedy's choice for Federal Power Commissioner, will meet little organized opposition. *Electrical World* hears that word of Swidler's downfall is highly exaggerated. Not even strong opponents are planning to crusade against him.

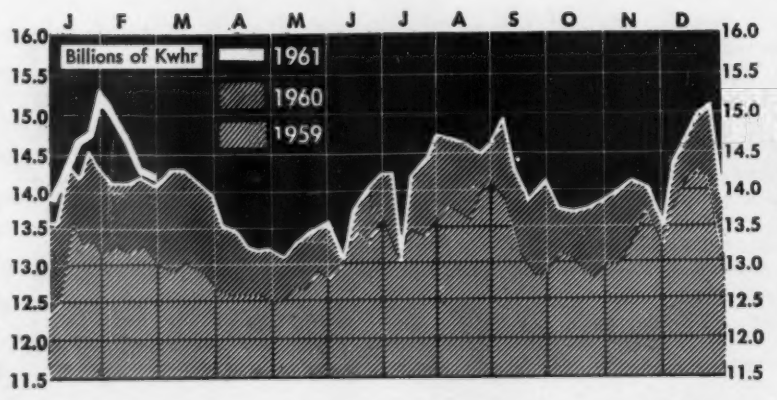
Pumped storage power plants at federal multipurpose projects get a boost in identical bills introduced by Wayne Aspinall (D-Colo.) and Walter Rogers (D-Tex.) The bills authorize Interior Secretary Udall to study 1) possible charges against non-federal operators who build pumped-storage facilities at federal reservoirs, and 2) changes necessary in federal laws to make the projects possible. Strong backing for pumped storage comes from Southwestern Power Administration Director Douglas Wright.

Dr Leland J. Haworth, director of the Brookhaven National Laboratory, is named to Atomic Energy Commission by President Kennedy. If Senate confirms the appointment, Republicans will hold a 3-2 majority on the Commission.

Ratification hearings on the US-Canadian Treaty for Columbia River will be held March 8 by the Senate Foreign Relations Committee. Both the Committee and the full Senate are expected to give quick approval as requested by President Kennedy in his natural resources report.

Application forms for preference power from Colorado River Storage Project will be in the mail by April 1 if remaining problems can be ironed out. These include final transmission line locations and delivery points, interconnections between the project and the Missouri River Basin Project, line capacity between Glen Canyon Dam and Four Corners steam plant, and rate schedules to assure an average return of 6 mills per kwhr.

WEEKLY POWER OUTPUT—Up 0.3% (Week ending Feb. 25), Kwhr 14,239,000,000



Per Cent Change From Previous Year

	Feb. 11	Feb. 18	Feb. 25
Total U. S.	+ 4.0	— 0.1	+ 0.3
New Eng.	+ 5.4	+ 5.3	+ 4.5
Mid. Atlan.	+ 5.3	+ 3.3	+ 3.0
Cent. Indust.	— 2.4	— 5.6	— 5.9
West Cent.	+ 5.3	+ 2.0	+ 2.8
Southeast	+ 7.5	— 3.8	— 1.7
South Cent.	+ 7.3	+ 3.3	+ 4.0
Rocky Mount.	+13.2	+11.0	+10.7
Pacific			
NW	+ 3.1	+ 3.0	+ 4.0
SW	+ 5.2	+ 7.4	+ 6.1

Seasonally Adjusted Index 269
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Source: Edison Electric Institute

Supply Lines

PRICES RAISED ON POWER CAPACITORS, LOWERED ON WATTHOUR METERS

Two price moves were announced last week as *Electrical World* went to press. On standard watthour and watthour-demand meters, General Electric Co cut the price 50¢ off list (30¢ off net) for single-phase units and $1.00 off list (60¢ off net) for polyphase units. The new prices were effective Feb. 27 and apply to all shipments made on or after that date. GE attributed the price decrease to lower manufacturing costs due partly to automation. **Prices** of demand and other specialty meters remain unchanged, GE said.

Meanwhile, Federal Pacific Electric Co has raised the price of Cornell-Dubilier power capacitors to $117 net for 50-kvar units in the range of 2,400 to 7,900 v, and to $234 net for 100-kvar "Slim Jim" units in the same voltage range. The new prices took effect March 1. At the same time, FPE said prices of pole-type racks and stack racks would be increased accordingly.

The last announced price change for power capacitors was Dec. 22 when GE dropped its price to $100 for 50-kvar units after making an unsuccessful attempt to raise prices (EW, Jan. 2, p 13).

TWO PUC'S TAKE FORMAL ACTION ON POSSIBLE DAMAGE CLAIMS

Two public utility commissions took formal action last week in conjunction with the antitrust cases against the electrical manufacturers. In Florida, the Railroad and Public Utilities Commission sent a directive to all investor-owned utilities in the state saying that if the antitrust violations had caused over-pricing, "then the investment of the utilities may also be correspondingly, albeit in good faith, overstated by them and such overstatement . . . would be reflected in the rates charged the public." As a result, the commission has directed the utilities to get any money back that they are entitled to and to keep the commission so informed.

And in Pennsylvania, the PUC asked the presidents of ten investor-owned utilities whether and to what extent the price-fixing and bid-rigging reflected on service costs and what legal action was contemplated to recover possible losses. The utilities were asked to furnish the information as soon as possible.

Meanwhile, attorneys representing some 60 major cities across the country met in Washington under the auspices of the National Institute of Municipal Law Officers. The attorneys discussed the possibility of filing one big damage suit, and appointed a task force to work on it. The task force is now digging into the records looking for patterns of identical bidding and other possible signs of collusion. In six weeks, NIMLO hopes to have this information and sometime after that a decision will be made on filing a consolidated suit.

One possibility the attorneys discussed was that the suit would not be restricted to products covered by guilty pleas, but might extend to the *nolo contendere* plea area, and possibly to areas in which there were no indictments. Their reasoning is that the manufacturers would be given the choice of settling out of court or of facing a public airing of the charges. This is because guilt would first have to be established in the *nolo* and non-indictment product groups before damages could be claimed. How successful they would be in proving guilt would depend on what information the Justice Department has that could be made available to the cities without violating the secrecy of the grand jury investigations. Attorney General Robert Kennedy has reportedly offered "100% cooperation."

In another development, the National Rural Electric Cooperative Assn has voted to give members advice and help on pursuing possible damage claims but only in response to requests by individual co-ops. Generally, co-ops are waiting to see what the federal government will do on damage actions.

RESIDUAL OIL IMPORT QUOTAS WILL PROBABLY BE KEPT

East Coast residual oil users have received little assurance from the Administration that import quotas on the fuel will be lifted. The quotas were imposed two years ago along with crude oil quotas at a time when the volume of oil imports was rising. But residual users on the East Coast, including electric utilities, say demand for the product is increasing while US production is declining as US oil companies find ways to extract more lucrative products from the crude oil, leaving less residual oil. This growing imbalance of supply and demand makes residual more dear, users say, and increased imports should fill the gap.

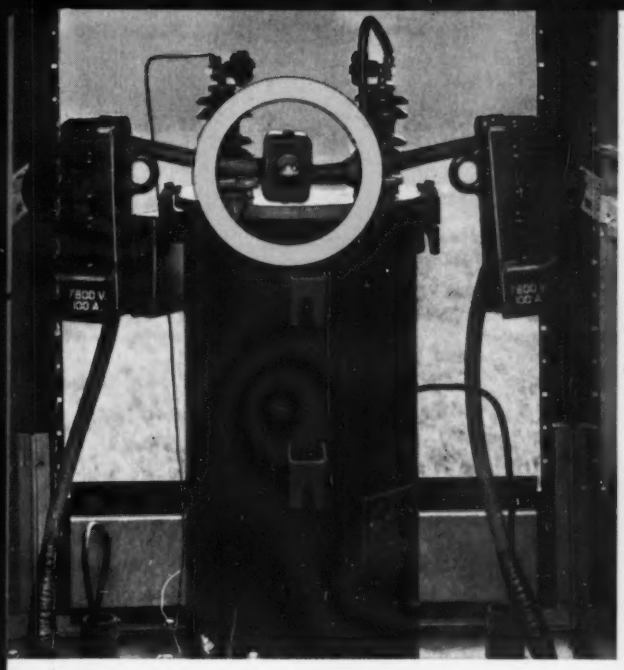
Competing with residual oil on the East Coast is the coal industry which strongly supports the import quotas. For instance, when the Kennedy Administration raised the first-quarter quotas about 20% recently, the National Coal Policy Conference said the effect of the move would be to wipe out the work of 1,000 coal miners for a full year. Residual users disagree, maintaining that coal's biggest competitor is really natural gas.

No matter who competes with whom, the conflict between Washington lawmakers from East Coast residual oil-consuming states and from coal-producing states is very real and sharp. And in the face of the current economically depressed coal regions, observers doubt the Administration would go as far as to lift the residual quotas entirely, regardless of how good a case the residual users might present. As Interior Secretary Stewart Udall said at a recent hearing on the matter, "The oil import program in general has served the public interest and is important to our national security; of course, the residual controls are an essential part of that program."

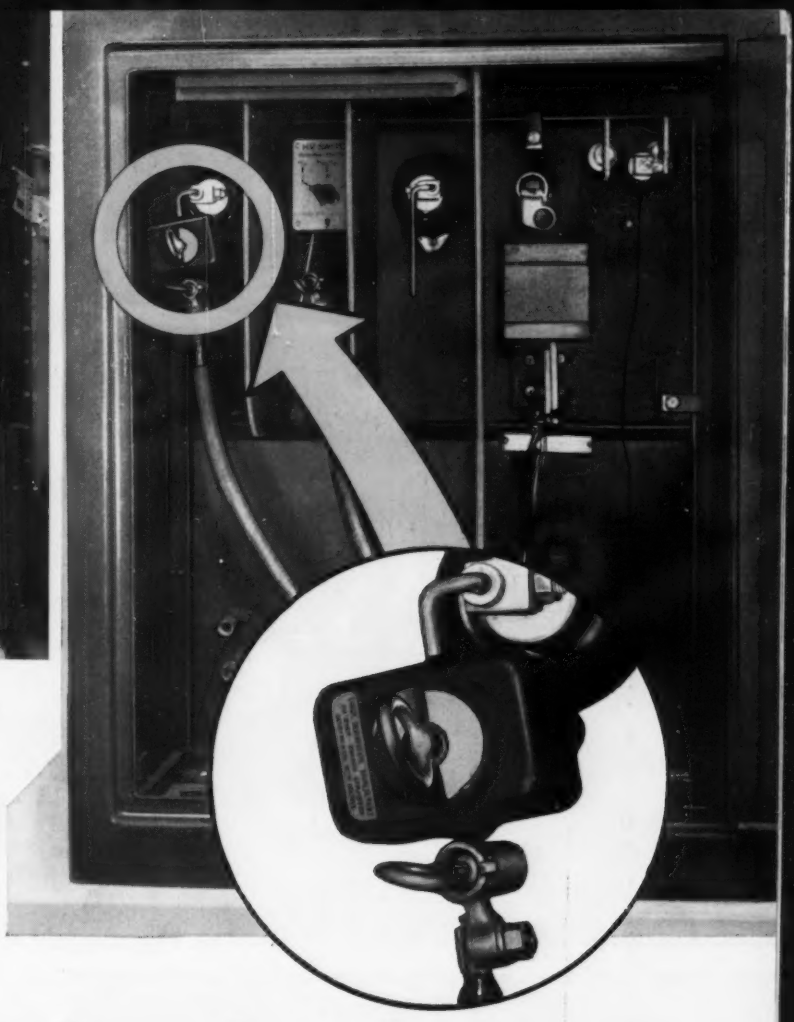
TACOMA BOARD HITS IDENTICAL BIDS; BUYER SUED IN KENTUCKY

Bid awards make news again. In Tacoma, Wash., the utility board awarded an $87,299 contract to Hill Transformer Co for Tacoma City Light's 1961 supply of transformers. Hill was low bidder but quoted on standard-loss transformers. Four other firms quoted on low-loss units but were higher and all identical. Although City Light recommended that all five firms share in the contracts because the more expensive equipment would provide better service, the utility board refused to go along, since Hill's bid actually complied with the bid specifications. At the same time, a board member explained, "We also have an opportunity here to express our dissatisfaction pointedly against identical bidding."

In Owensboro, Ky., Westinghouse Electric Corp has filed a suit against the city utility commission to keep it from awarding a $3,500,000 contract to General Electric for a 125-Mw turbine-generator. According to the suit, Westinghouse's $3,415,000 bid was lower, even after evaluation by an engineering firm and therefore by law it should have been the winning one. But the commission voted to give GE the contract, saying other factors besides price were involved. The suit also challenges the legality of the commissioners' appointments, the bids, and the instructions to bidders.



New L-M Fault Indicator mounted on the primary feeder in a transformer installation in an L-M Transclosure.



L-M Fault Indicator mounted on a primary feeder in an L-M Pad-Mount transformer. Indicator may be mounted either vertically or horizontally. To reset, just turn the handle. (Inset): Fault Indicator has tripped, exposing yellow section, showing that a fault exists beyond this point.

L-M's Economical Fault Indicator Quickly Locates Underground Faults

L-M's exclusive new Fault Indicator is a simple, inexpensive device primarily for installation on underground feeders in Pad-Mount® transformers or Transclosure™ housings. Should a fault occur, the Fault Indicator shows the general location, between adjacent transformers or sectionalizing points. One fault-hunting job could well pay for the installation of these L-M Fault Indicators.

The indicator can be applied to all underground circuits regardless of voltage. Over-current through the cable trips the indicator, which flips a yellow segment into view. Rating is 350 amperes nominal trip current. The indicator is mounted simply by threading the cable through the indicator yoke, and tightening the clamp.

The Fault Indicator also facilitates location of a faulted phase of a three-phase system. Fast half-cycle operation permits coordination of the indicator with protective devices over a wide fault-current range. And it costs less than $10!

Get Details On This Money and Time-Saver

Ask the L-M Field Engineer for details, and time current curves on this valuable, economical device. Or write Line Material Industries, Milwaukee 1, Wisconsin.

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Please have L-M Field Engineer tell me how I can save time and money with the L-M Fault Indicator.

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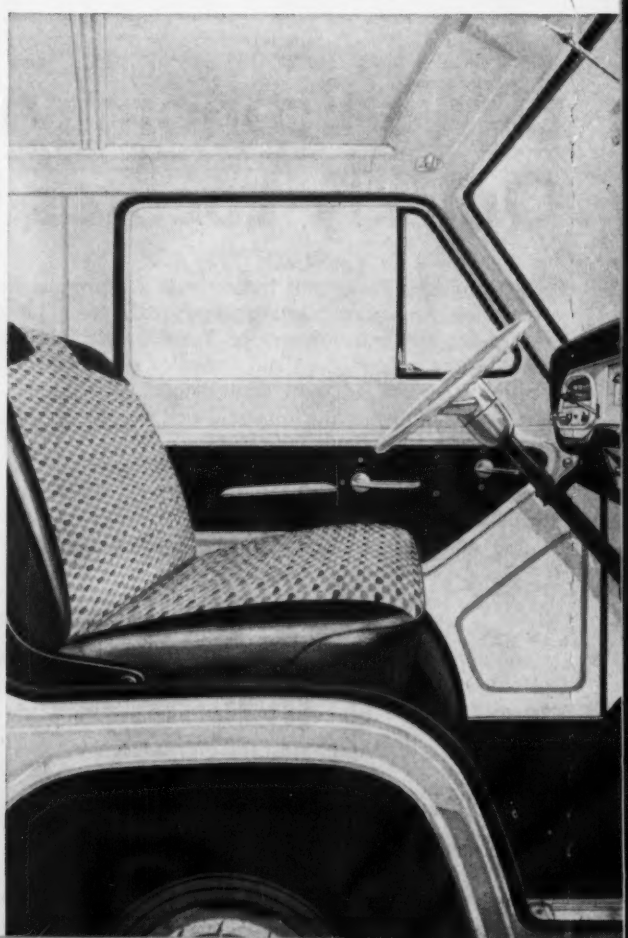
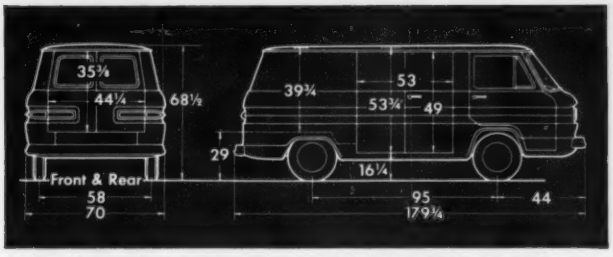
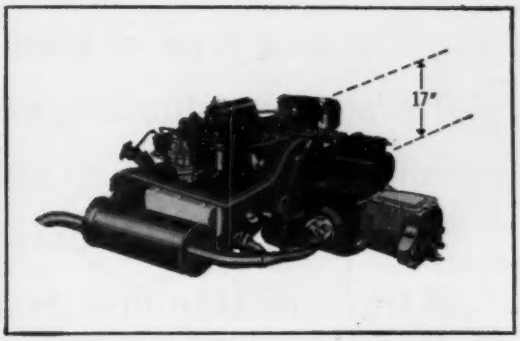


TOTALLY NEW ★★★★★★ CHEVROLET CORVAN MADE TO MEASURE FOR MORE EFFICIENT DELIVERY DUTY!



Measurably more load space than conventional half-tonners! Cargo area is almost 10 feet long, thanks to rear-engine design which eliminates the hood.



Corvan's rear-mounted "pancake" 6 measures only 17" high, top to bottom; it allows maximum load space in truck interior and lower loading height; and it packs plenty of power to boot!

■ Size up a new Chevy Corvair 95 Corvan and you'll see scores of features and dimensions that measure up to a new standard of profit-producing performance. Look at the whopping-big load space, for instance, made possible by the efficient rear-engine no-hood design. Or check the nearly *even* weight distribution, front and rear, that enables a Corvan to carry up to 1,700 lbs. of payload with a 4,600-lb. GVW.

Note, too, the short 95-inch wheelbase that pays off in nimble maneuvering and easy parking. And, while you're at it, try Chevrolet's newest engine, Corvan's rear-mounted aluminum Turbo-Air 6. Feel its fleet power and don't forget that it never needs anti-freeze or radiator repairs! (Tucked between the rear wheels, it stays out of the way and stays on top of fuel costs, too.)

But above all, don't miss the *quality* that's been engineered into this new panel. It shows up everywhere, but particularly in the chassis and body construction. In the tough integral floor-frame assembly, in the smooth independent 4-wheel suspension, and in built-to-last features like the two-position metal door checks and sturdy double-walled doors.

For eye-opening evidence of Corvan's unmatched utility, take a tape with you when you visit your Chevrolet dealer's and measure these advantages for yourself:

SPACIOUS DRIVER COMPARTMENT. Wide, unobstructed floor, plenty of leg room and head room. Full-width seat, 59¼" wide, is optional at extra cost.

BIG SIDE DOUBLE DOORS. They open so wide that you can load a 4' x 4' crate with ease! (Right-side doors standard; left-side doors optional at extra cost.)

EASY-LOADING REAR DOORS. These double doors are big enough (and open wide enough!) to make rear-end loading a breeze!

LOW LOADING HEIGHT. Only 16¼" at the side, only 29" at the rear (unloaded). Saves you work!

HIGH INTERIOR. Interior height is a full 4½ feet; that means more convenient cargo handling.

Your Chevrolet dealer can brief you fully on this new answer to more profitable deliveries, so see him soon. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

1961 CHEVROLET STURDI-BILT TRUCKS

CHEVROLET

LAPP CONTROLLED-POSITION CONSTRUCTION

A new type of insulator from Lapp offers cost reduction, economy of space and convenience of construction to solve many problems of transmission line design

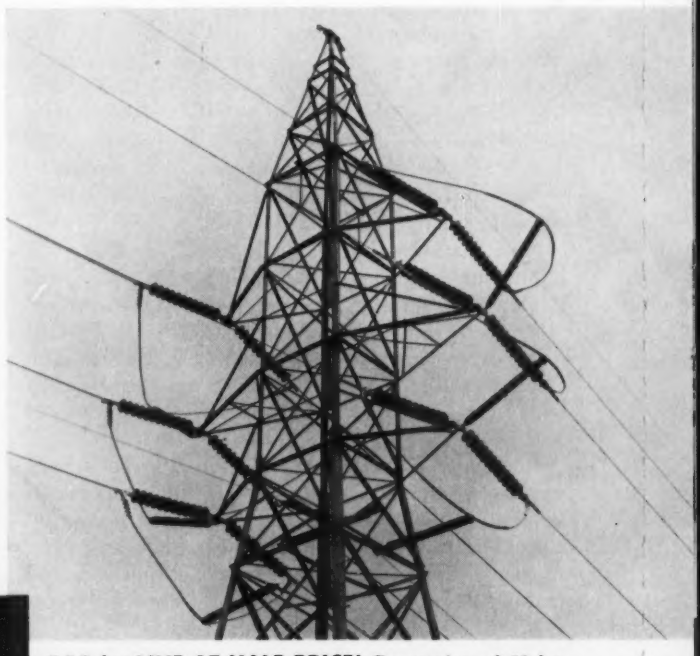
Lapp strut insulator, 117″ long, matches electrical and mechanical ratings of an 18-unit string of 5¾″ x 10″ standard suspension insulators.

Lapp Controlled-Position Construction is a new technique in transmission line design which utilizes porcelain rods or struts—with fog-type leakage corrugations—to hold in fixed position and/or restrain high voltage conductors.

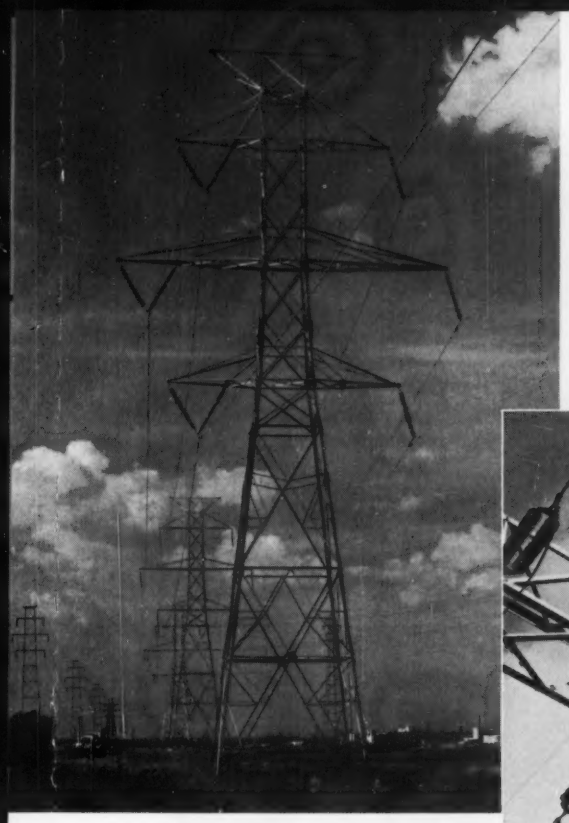
Use of Lapp Controlled-Position Construction on tangent structures invariably results in more compact design with consequent lower structure cost and narrower right-of-way requirements. Its use in jumper restraint provides neat efficient appearance and eliminates radio and TV interference such as is generated by lightly-loaded suspension strings.

WRITE FOR BULLETIN. Lapp Brochure No. 478 describes the development and application of Lapp Controlled-Position Construction . . . suggests design procedures . . . lists specifications and characteristics of Lapp strut insulators. Write for your copy.
Lapp Insulator Co., Inc., Le Roy, N. Y.

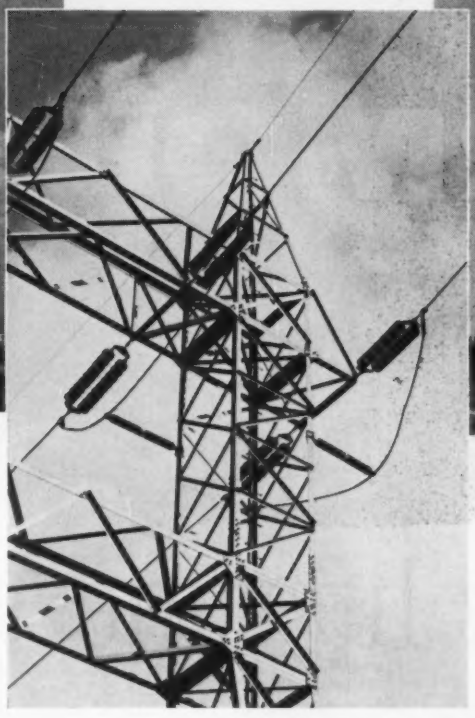
Lapp



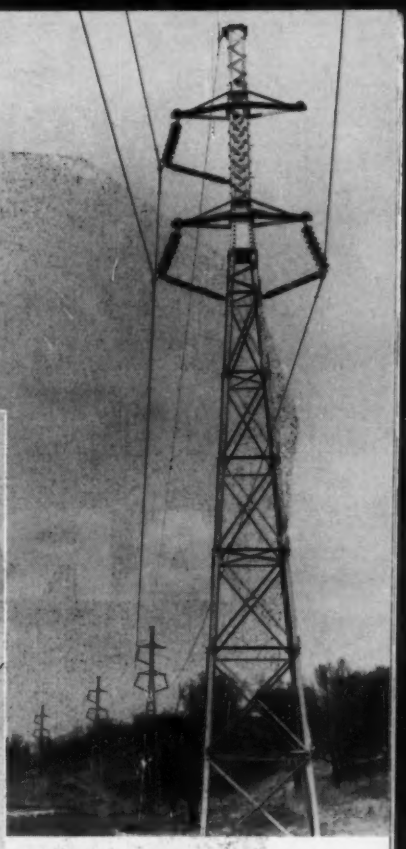
138 kv LINE AT HALF-PRICE! Conversion of 69 kv line to 138 kv accomplished with Lapp Controlled-Position Construction. Existing tower required only some reinforcement. Short crossarms are adequate, however, with use of Lapp strut insulators, to control dead-end jumpers, prevent their swinging, and maintain clearance from tower and between phases. Total construction cost: less than half that estimated for a new 138 kv line.



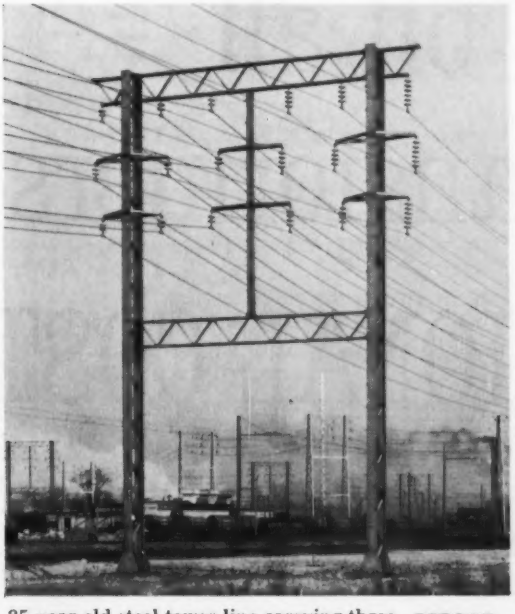
LONG JUMPERS STAY PUT! Lapp Controlled-Position Construction restrains long jumpers. This 115 kv dead-end structure keeps the line within its limited right-of-way—Lapp struts hold the 26 ft. jumpers safely away from the tower. No radio or TV interference either, as occurs with suspension strings used for jumpers.



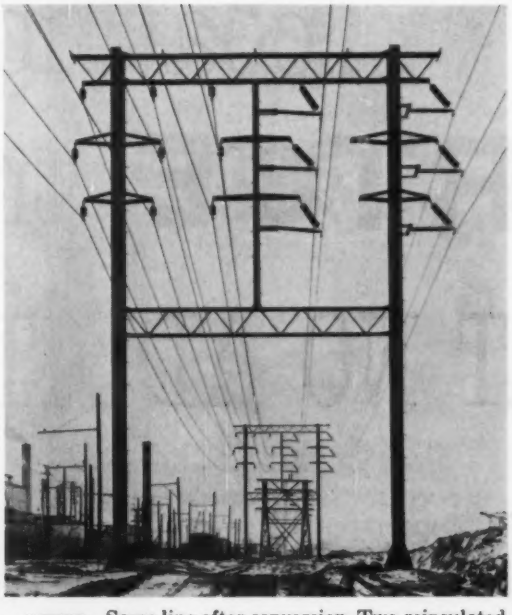
CUTS SHORT ON THE TURNS! Lapp Controlled-Position Construction is well suited for angle construction at high voltage. As on this 220 kv line, Lapp struts supported from crossarms and attached to lower end of suspension string are used to maintain clearance, holding conductor out and away from the tower. No need for longer crossarms, arm-end brackets or other construction that add cost or right-of-way requirements.



RADIO-TV INTERFERENCE ELIMINATED! As originally built in 1924, this 115 kv line used wood lower crossarms and tie-down insulators to stabilize conductor at angle structures. Recently reconductored, using Lapp Positioned-Construction. Lapp strut insulators position conductor and assure tower clearance. Radio and TV interference generated by tie-down insulators is now wholly corrected.



BEFORE 35-year old steel tower line carrying three 69 kv and three 12 kv circuits. Increased load required replacement of the three 69 kv circuits with two 115 kv circuits. The three 12 kv circuits were to be retained, and old portal-type steel structures were to be used; additional right-of-way not available.



AFTER Same line after conversion. Two reinsulated 115 kv circuits are suspended from original crossarms. Lapp strut insulators attached to extension brackets on the towers push conductor-insulator assembly up and out, provide adequate clearance between circuits, tower and ground. 12 kv circuits remain.

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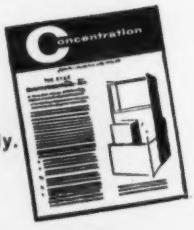
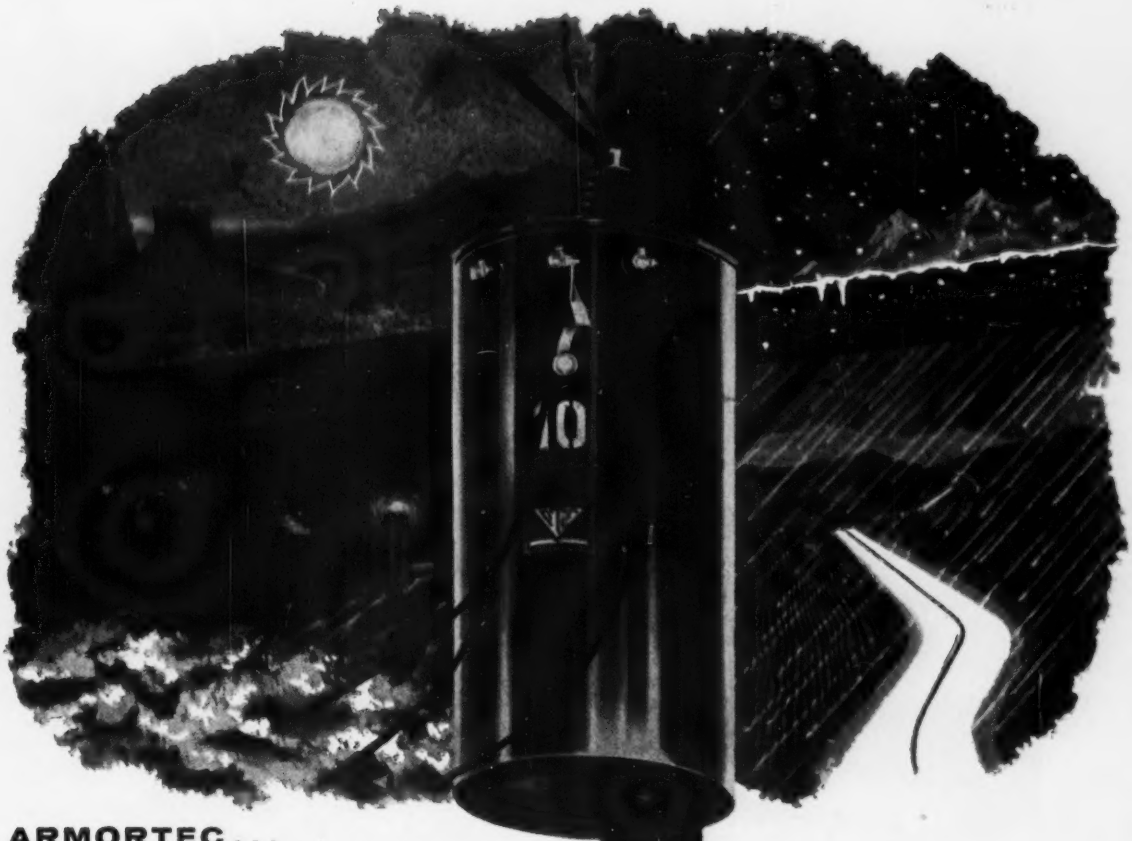
new lifetime VINYL coating on all **RT&E** transformers AT NO ADDITIONAL COST!

Get the complete facts on **RT&E ARMORTEC**

Write or phone your RT&E representative for the winter issue of the Concentration quarterly.





ARMORTEC...
100 TIMES BETTER THAN PAINT

Effective February 15, 1961, R T & E pole-type transformers will have ARMORTEC . . . a lifetime protective coating.

ARMORTEC is not a paint, it is a pure vinyl plastic. Oven-fused to the transformer cover, band and tank. ARMORTEC provides a thick protective coating that defies wear and weather even under the most tortuous atmospheric conditions. Thousands of hours of grueling laboratory testing proved ARMORTEC corrosion-proof, fade-proof, weather-proof, and maintenance-free. Tested in the salt air of Florida and the sand air of Arizona for over three years, ARMORTEC proved indestructible against salt spray, abrasion and sunlight.

ARMORTEC provides many more benefits, too:

- **Armortec coated cover and band eliminates outages due to birds and animals.**
- **Impact resistance that prevents chipping and scratching.**
- **Abrasion resistance 100 times superior to paint as proven by sandblast tests.**
- **A smooth, brilliant lifetime lustre that won't chalk, crack or craze.**
- **A fused-on film seal that eliminates bubbling and edge pull; provides uniform thickness even on corners; fills blind spots and corrosion traps present around lifting lugs, hanger brackets and accessories.**

ARMORTEC — the truly lifetime coating — will save you countless maintenance dollars through the years. And best of all, R T & E ARMORTEC is available to you *at no extra cost!*

Here again is another innovation in a long line of R T & E firsts — the result of **R T & E concentration on a single idea . . . build a better transformer for you.**

ask your
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to torture test
RT&E
ARMORTEC
in your office!

RT & E
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PORTLAND, OREGON
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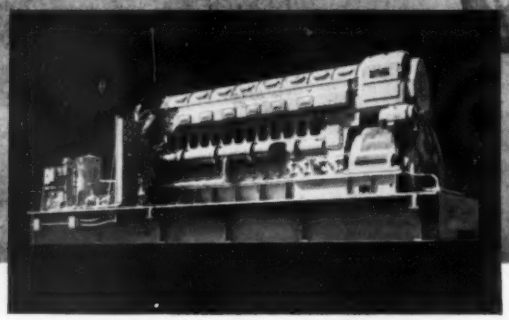
NOW! FULL POWER IS 15 SECONDS FAST!



Solve peak-load and standby problems! F-M's exclusive O-P Diesel Generating Units provide *full* power in 15 short seconds . . . *from a cold start!* They need no spinning reserve. Use no power till you use them! The reason? Our exclusive O-P (Opposed-Piston) design. Two pistons in one cylinder function from a *single* combustion. This minimizes *vibration* . . . produces fine *balance, smooth* power to peak the generator—in just 15 seconds! F-M Opposed-Piston Diesel Generating Units are available with automatic or manual controls. Produce up to 2500 kw per unit. They may be linked in multiple units for peaking, standby duty . . . or dead load pickup! You can't buy better—or more economically.

For full details or custom specifications, write today to: **Mr. S. K. Howard; Diesel Division; Fairbanks, Morse & Co.; Beloit, Wisconsin.**

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A New Phase: Equipment Price Fairness

A completely new phase of the antitrust situation now has taken the center of the stage. It concerns possible damage claims against some of the electrical equipment manufacturers involved in the Philadelphia suits.

Clearly, this is a different subject. Since its impact is on whether prices of electrical equipment were fair, rather than on the mechanism by which prices were set, it gives the opportunity for the manufacturers to demonstrate their remarkable contributions to the utility industry.

This newly spotlighted area of interest concentrates on prices paid by utilities for electrical equipment over a period of several years. Completely objective, quantitative determination of the fairness of these prices will require the wisdom of a Solomon, so complex is the situation. Resolution of differences existing between buyers and sellers demands a complete honesty of approach by all concerned, as devoid as possible from emotional clouding.

Speculation in the press that manufacturers considered themselves ripe for substantial damage settlements has been countered by statements from at least some suppliers that no liability is admitted. As reinforcement for this, the following approach is being pressed:

1. Prices paid by utilities over the period in question represent fair values.
2. Far from permitting excessive profits, these prices have assured continued innovation of the type which historically has supported rising equipment ratings and efficiencies.
3. The net result is the constantly declining unit price and increasing reliability of electricity to the ultimate consumer, despite inflation.

We subscribe wholeheartedly to this logic as a general concept (EW, Sept. 12, 1960, p 90). It is clear that the utilities, down the years, willingly have purchased innovation and progress as a component of value in their equipment.

It is equally clear that the cost of the supporting research and development is not low, and that in general the utilities have not objected to paying for it, because it produced results. The combined utility/manufacturer industry has done a remarkable job in holding down the ultimate cost of the utility kwhr while measurably improving service reliability. That much is fact.

It is not likely, of course, that contentions of this general "proof-of-the-pudding" type will be sufficient to prove or disprove completely the fairness of equipment prices. It is not clear at this point precisely what approaches will be followed. This much we believe: Any damages must be based on provable points.

But we are confident that discussions, negotiations, and, if necessary, court actions, in seeking provable points, will disclose abundant support for the thesis that a continued high level of research and development is necessary, and that the cost of R&D allocated to equipment prices over the period in question was not excessive, considering the results of such a long-term approach.

Because of the complexity of the situation, any evidence presented, pro or con, must be weighed by minds completely free of bias or emotional loading. The only matter in question here is: Were the prices fair?

It is necessary, finally, to reflect that improper judgment in this matter can well work to the long-term detriment of the ultimate user of electricity.

Message to Congress Emphasizes

Greater federal participation in power transmission is proposed; support of preference clause clearly reasserted

President Kennedy's special message to Congress on natural resources stirred pro and con comment on Capitol Hill, though it contained no surprises and mentioned no specific projects.

The President's resource report met with instant approval from Sen Clair Engle (D-Calif.), who called it a "stirring challenge." He praised both the plan for "optimum power development" at federal multipurpose projects and the plan for common carrier transmission lines: "I anticipate that some positive proposals will be made to the Congress on the subject this session." Engle added that he would have preferred a separate resources council at the White House (as in his bill) but he would accept Kennedy's proposal to put the group under the Council of Economic Advisors.

The report also met criticism from GOP senators. Much of it was set off by Kennedy's charge that the previous Republican Administration had adopted a "no new starts" policy, which "took a heavy toll in added costs and even human life."

Sen Wallace Bennett (R-Utah) called the report "one of the most politically oriented ever presented to Congress," and said he was writing the President for a list of the persons whose lives were lost as a result of the "no new starts" policy. Bennett also called the Kennedy proposals "a vast program of nationalized power and of nationalized interconnecting power lines." Sen Barry Goldwater (R-Ariz.) called the report "a mish-mash of distortion and political propaganda."

The new Administration's power policies are oriented toward "public power." The extent to which it plans to liberalize the power policies of former President Eisenhower varies with the subject it's dealing with. Here are the report's highlights involving power:

• Inter-regional high-voltage transmission lines should be built by the federal government to connect its present power marketing agencies—Bonneville, Southeastern and Southwestern Power Administrations, Tennessee Valley Authority, and other Bureau of Reclamation and Corps of Engineers projects. In addition, many of the lines would be built and justified as "common carriers" to wheel power for all comers.

Likely line to be built first is between Bonneville Power Administration and California's Central Valley Project. Others would be between Bonneville and the Missouri River Basin Project; between the Missouri Basin Project and the Colorado River Storage Project, and between Central Valley and the Colorado project. Part of this proposal calls for building all-federal transmission lines in the Colorado storage project—a plan to be fought this spring in the Senate and House appropriations committees by mountain states power companies (EW, Jan. 30, p 29).

Kennedy, in his previous economic message to Congress, called

Text of Kennedy's Electric Power Section Report to Congress

To keep pace with the growth of our economy and national defense requirements, expansion of this nation's power facilities will require intensive effort by all segments of our power industry. Through 1980, according to present estimates of the Federal Power Commission, total installed capacity should triple if we are to meet our nation's need for essential economic growth. Sustained heavy expansion by all power suppliers—public, cooperative and private—is clearly needed.

The role of the federal government in supplying an important segment of this power is now long established and must continue. We will meet our responsibilities in this field.

Hydroelectric sites remaining in this country will be utilized and hydroelectric power will be incorporated in all multiple-purpose river projects where optimum economic use of the water justifies such action.

The Tennessee Valley Authority will continue to use the financing authority granted it by the last Congress to meet the power needs of the area it serves.

Our efforts to achieve economically competitive nuclear power before the end of this decade in areas where fossil fuel costs are high will be encouraged through basic research, engineering developments, and construction of various prototype and full scale reactors by the Atomic Energy Commission in cooperation with industry.

In marketing federal power, this Administration will be guided by the following basic principles which recognize the prior rights of the general public, consumer and taxpayer who have financed the development of these great national assets originally vested in them:

(1) Preference in power sales shall be given public agencies and cooperatives.

(2) Domestic and rural consumers shall have priority over other consumers in the disposal of power.

(3) Power shall be sold at the lowest possible rates consistent with sound business principles.

(4) Power disposal shall be such as to encourage widespread use and to prevent monopolization.

Finally, I have directed the Secretary of the Interior to develop plans for the early interconnection of areas served by that Department's marketing agencies with adequate common carrier transmission lines; to plan for further national cooperative pooling of electric power, both public and private; and to enlarge such pooling as now exists.

'Pooling'

for these lines to "interconnect our hydroelectric and thermal power resource plants;" and the earlier Kennedy-Johnson resources report (headed by Rep Frank Smith, D-Miss.) also said the Interior Department "must re-assert its responsibility to provide long-range planning of generation and transmission facilities to meet future needs."

• Kennedy's plans for expanded power pooling programs and for "further national cooperative pooling" are general but appear aimed in two directions for the moment: **(1)** Expansion of existing regional pooling arrangements, such as the Northwest Power Pool, and other interconnected systems across the US, **(2)** A very slow, but steady push toward either federal or joint (federal-public-investor-co-op) systems, operating major generation facilities, and making this power available to existing systems at wholesale—the concept of the late Leland Olds' "giant power" system. This second phase is a long way off, but definitely in the planning stages.

The earlier Kennedy-Johnson resources report said: "Regional wholesale power supply systems should be made responsible for meeting the expanding wholesale power requirements of all retail electric systems . . ."

• Revised feasibility standards for federal multipurpose projects are almost a certainty.

Kennedy's request for a 90-day review of present feasibility standards for federal multipurpose projects is a coincidence, in that the present budget director, David Bell, will be asked to review the existing standards (A-57) which were established in December, 1952, when he was head of the natural resource section of the Bureau. Actually, Bell didn't write the present standards, but they came across his desk.

Other Administration plans on this line call for inclusion of additional criteria—such as recreation—in allocating costs at federal projects. And the "Trimble Bill," calling for reduced allocations against power facilities, is another likely subject of Administration approval.

Something to watch in this area will be the Administration's drive for building federal pumped storage generating facilities at multipurpose sites where hydro power is used primarily for peaking. SWPA Administrator Douglas Wright has made such a recommendation to Interior Secretary Udall, the National Rural Electric Cooperative Assn has endorsed the plan, and Chairman Wayne Aspinall (D-Colo.) of the House Interior Committee has introduced legislation to authorize Udall to make such a study. Pumped storage facilities could change the economics of many border-line federal projects.

• Kennedy's planned creation of a Presidential Advisory Committee on Natural Resources differs slightly from the proposal of Sen Engle, who has introduced a bill (S-239) to create such a group, but the executive order would remove any chance for Congressional debate on his plans.

Kerr Recommendations Accepted

The President has accepted all of the recommendations and requests of the recent Senate water report (headed by Sen Robert Kerr, D-Okla.), and much of his resources report is based on the Kerr group's findings. The Kerr staff, incidentally, is still preparing specific legislation to implement its general recommendations made earlier this year (EW, Feb. 6, p 39, Feb. 16, p 51). These bills will be introduced by chairmen of the Senate Commerce, Interior, Public Works and Agriculture Committees, when their chances of passage seem best.

'Responsibilities' Are Federal

An ambiguous reference to federal "responsibilities" to supply power raises the question of whether the President is referring to "utility responsibility." Capitol observers feel the President isn't ready yet to embark on such a program. What he means is the making available of as much power to preference customers as can be generated from federal projects.

And the President's mention of "domestic and rural consumers" as having special priority, as part of the federal preference clause, is also general. The federal government will continue to supply power wholesale to preference customers without questioning the ultimate use.

Paxton Retires From GE Presidency

Robert Paxton, president of General Electric Co, is retiring after 37 years of service. Ralph J. Cordiner will assume the responsibilities of president in addition to his duties as chairman of the board until April 26th when a new president will be elected at the annual shareholders meeting.

In announcing the retirement, Cordiner said, "Mr Paxton's decision to retire before his long-intended goal of age 60 is unfortunately precipitated by the need for a continuing period of convalescence following major surgery in January." Paxton celebrated his 59th birthday last month.

During the past ten years, Paxton has held the positions of officer-in-charge of manufacturing services, group executive, and executive vice president for all company operations. He succeeded Cordiner as president in April, 1958.

As a consequence of Paxton's retirement, Cordiner will resign as Chairman of the Business Advisory Council. "With Mr Paxton's retirement, I believe my time and attention must be devoted solely to the affairs of the company," he said. Cordiner will continue to be a member of the Council, however.

US Vs Private Power Battle Looms

House subcommittee report says fight will occur when hydro project 50-year licenses begin expiring after 1970

"A federal versus private power fight of unprecedented proportions looms in the near future," reports the House Legislative Oversight subcommittee in its report on independent regulatory commissions. This fight, says the subcommittee, will involve the fate of utility hydroelectric projects when their 50-year licenses (issued by the Federal Power Commission) begin expiring in large numbers after 1970.

Actually, the subcommittee's prediction and comments—filled with dire implications—are only a teaser. The whole matter was covered in a single paragraph in the House group's lengthy report. Most of the report was devoted to other commissions, or to other matters (mostly gas) involving the FPC.

The last concerted effort by the subcommittee to review the FPC's 50-year licensing practices—and what happens when those licenses expire—took place a couple of years ago, and the subcommittee's findings were inconclusive. The latest reference to the subject is based on those same 1958 hearings.

The subcommittee's reference to 50-year licenses reads as follows: "Section 6 of the Federal Power Act, as amended, grants the Commission authority to issue licenses for hydroelectric projects for a period not exceeding 50 years. In a few years many of these licenses will terminate. Congress will then be faced with the problem of disposing of these projects. A federal versus private power fight of unprecedented proportions looms in the near future (after 1970), and steps should be taken now to resolve some of the foreseeable problems connected with these 50-year licenses. This was a subject of recommendation in an earlier report of the subcommittee (House Report 2711, pp 12-13)."

The 1958 subcommittee report, mentioned above, followed a short but heated hearing in September, 1958. Subcommittee Counsel Francis X. McLaughlin criticized the FPC at that time for deviating from apparent previous policy by granting new 50-year licenses for several existing but previously-unlicensed projects which were enlarged or combined with new projects in their license applications. FPC General Counsel Willard Gatchell defended the policy, claiming it wasn't new, and was in conformity with FPC's regulations (EW, Oct. 6, 1958, pp 64-65).

Gatchell, at that hearing, also emphasized that federal payment of severance damages to power companies for their dams where licenses had terminated might keep the federal government from taking over most projects.

FPC Chairman Jerome Kuykendall, following the 1958 hearing, made two recommendations (which he admitted might be complicated) involving initial FPC licensing of constructed but unlicensed projects. He made no recommendations for the problem of license terminations beginning in 1970.

His recommendations for licensing of existing, unlicensed dams were: **(1)** Amend Section 10 (D) of the Federal Power Act to provide that projects already in operation for more than 20 years should be required, at the time of the license, to start an amortization reserve—normally required to be started on a new 50-year license after 20 years of operation; **(2)** Penalize all existing but unlicensed projects which do not apply for licenses within a year of enactment of this amendment, so that they could never secure one extending beyond 1970.

Both Gatchell and Kuykendall, however, maintained repeatedly that nothing should be changed to prevent the FPC from being able to authorize the most comprehensive possible stream development—often through renewed licenses for improved projects or "package" licenses involving old and new dams.

The regulations involving license terminations permit the government to take over licensed projects after 50 years' operation, providing the licensee is paid his net investment plus "reasonable" severance damages (which Gatchell feels may be an obstacle). If the federal government doesn't choose to take over the project, the FPC can renew the license for another 50 years (or whatever period the law then permits) to the original licensee, or it can issue the license to a new licensee on payment of the same net investment and severance charges. If none of the above take place, the FPC must issue a yearly, renewable license to the original license holder.

New FPC General Counsel John Mason says several utilities have questioned the workability of the renewed, yearly licenses, but he feels financing and operations would be possible. He points out that, in such an event, financing of repairs or improvements to the dam would be based against the entire system; not against the single project.

Utilities Appeal FPC Accounting Decision

The Federal Power Commission's unfavorable order against accounting procedures used by 76 electric utilities, in accounting for their contributions to ECAP (Electric Companies Advertising Program), has been taken to federal court, as expected.

An appeal to the Fifth US Court of Appeals (New Orleans) has been made by 63 of the utilities in three separate cases: Southwestern Electric Power Co separately, Alabama Power Co with nine other companies, Arizona Public Service Co with 51 other companies.

The FPC staff, respondent in the upcoming case, must file its brief by May 1, and the case probably won't be argued until fall of 1961.

The companies are challenging the Commission's Aug. 17, 1960, ruling against their accounting for ECAP contributions as reasonable business expenses. Instead, the FPC required them to place such contributions in a "below-the-line" category, to be paid out of profits, because the challenged ads were "political in nature"—criticizing unfair federal competition with their systems.

Opinions Vary on Nuclear Status

Partnership with industry seriously questioned as most efficient means of developing economical nuclear power

Hearings just concluded before the Joint Senate-House Committee on Atomic Energy show there are still plenty of differences over the status of US nuclear power programs.

Some of the 43 government and industry participants said that present efforts were adequate; others believed them lagging.

For the first time since the government unveiled its ten-year nuclear power program last February, AEC commissioners conceded that partnership arrangements with industry may be inadequate for achieving the program's national objective: economic nuclear power by 1968.

Two causes were blamed in the hearings for setbacks in 1960 to six major reactor projects. These were the problems of determining reactor sites and related safety problems and utility company reluctance to take on the financial burden of the present cooperative program, according to AEC's lead-off testimony.

Safety Gets High Priority

Commissioner Robert S. Wilson at one point in AEC's testimony said that public health and safety would always override a desire "to push ahead with a vigorous development program if the two objectives should be in conflict."

The problem of finding a workable formula for building commercial size reactors under the terms of the ten-year program is sufficiently serious, Commissioner Wilson noted, that AEC is now making a major policy review of the civilian power program.

Rep Chet Holifield (D-Calif.), chairman of the Joint Committee, said the $15 million in the fiscal-'62 budget for reactor construction is an insufficient amount for launching necessary power projects under the long range program.

Holifield indicated, however, that he did not intend to start a battle over expanding the reactor budget unless the Kennedy Administration "woke up to the importance of nuclear power" and recommended a financial step up.

Philip Sporn, speaking for American Electric Power Co, disagreed with Committee Democrats and their views that nuclear power development is falling behind.

Sporn said, "I believe on the whole that we have made an excellent record and have made some marvelous progress. If it doesn't add up to kilowatt-years, it adds up to an impressive list of reactor projects that has produced an amazing amount of engineering knowledge."

Sen Albert Gore (D-Tenn.) objected to Sporn's statement. Gore said it was still his view that "utilities could profit enormously by concentrating the development of atomic energy on the government."

"Your experience confirms that one company cannot afford to develop nuclear power, yet the whole country cannot afford to fail in the development of nuclear power," Gore told Sporn.

Sporn's answer was: "We're not doing badly. We're doing extremely well. We're doing better than any other country I know anything about. We're perhaps too impatient with ourselves."

James L. Grahl, director of atomic energy for the American Public Power Assn, proposed that AEC abandon the so-called partnership approach to reactor development and construction by government and business.

Instead, he said, AEC should establish a "sufficiently large and experienced" civilian nuclear power division to promote and administer all facets of the civilian reactor program.

Udall Told Projects Must Be Justified

Don't "embarrass" the House Interior Committee by recommending public works projects which can't be justified as reclamation projects, Committee Chairman Wayne Aspinall (D-Colo.) has advised Interior Secretary Stewart Udall.

Aspinall's comments — made when his committee held a "get acquainted" session with the new Interior officials—were in reference to recent plans by Udall to step up project construction as anti-recession measures.

"If there is a step-up in reclamation construction work," Aspinall asked Udall, "will it be your policy to continue to recommend that we conform to those feasibility policies which Congress has decided on, and, if you cannot recommend the conformance to such policies, will you be able to differentiate between what used to be called a 'National Recovery Administration' and a reclamation program? Will it be possible for your Department to so enunciate that in trying to get Congressional action in the future, especially that we would not be embarrassed by projects that are brought about during an economic situation that otherwise could not be treated by Congress?"

Udall agreed, adding, "We do not foresee, at the present time, the type of action that might get us in the situation. But, I think, if we do, we should make it very plain that we know exactly what we are doing, and if we are setting up a different set of standards, that we are doing it for specific reasons . . ."

Aspinall also spanked Udall lightly for his recent pronouncements on a new power "policy." Policy, said the committee chairman, is made by Congress, and the Department only makes recommendations. Aspinall also urged Udall to invite a committee representative to be present "when you take to the declaration . . . of certain programs" which require a "cooperative effort between the policy-making body of the federal government and the administration body."

(*See Udall statement, p* 76)

AEC Annual Report Shows Progress

Site difficulties threaten some projects of the future, but those completed and under construction help totals

Total US nuclear electric capacity more than doubled in 1960. A gain to 365 Mw installed, or a net addition of 290 Mw over the previous year's 75 Mw, is listed in the Atomic Energy Commission's annual report.

The added nuclear power came from Commonwealth Edison Co's 180-Mw Dresden station, which attained full power operation in June, and completion of the 110-Mw Yankee Atomic pressurized water reactor power plant in August.

Completion of 15 power reactor projects under construction will hike nuclear capacity to 1,000 Mw by 1963, according to the report.

The additional nuclear build-up is to come from completion of six atomic power projects in 1961, providing a total of 294 Mw; completion of nine projects in 1962, totaling 355 Mw; and the Philadelphia Electric Co high temperature gas-cooled project in 1963, adding 40 Mw.

Costs Steadily Lowering

The report gives evidence that nuclear power costs are steadily lowering. For instance, the letter of intent Southern California Edison Co sent to Westinghouse Electric Corp would contract for construction of a 360-Mw pressurized water reactor. Westinghouse offered to build the full-scale power reactor, the AEC report says, with price and performance guarantees that would result in "power costs very nearly competitive with conventional costs in high fuel cost areas."

Empire State Atomic Development Associates, Inc, a seven-utility group in New York state, entered into a research and development program which would lead to development of a 300 to 500-kw commercial-sized economically competitive plant, as a further example of progress to lower nuclear costs.

AEC listed these reactor construction starts for 1960:

(Privately Financed Projects)—Saxton Nuclear Experimental Reactor at Saxton, Pa.; Humboldt Bay power plant at Eureka, Calif.

(Federal Cooperative Nuclear Power Development Projects)—Consumers Power Co boiling water reactor at Big Rock Point, Mich.; nuclear superheat reactor of the Puerto Rico Water Resources Authority at Punta Higuera, P. R.; Carolinas-Virginia heavy-water and pressurized tube reactor at Parr, S. C., and the experimental organic-cooled reactor owned by the Commission at National Reactor Testing Station in Idaho.

The report noted some of the difficulties and delays encountered by development of atomic power during the year:

Re-definition of the Florida West Coast Nuclear Group's 50-Mw gas-cooled, heavy water-moderated reactor was accomplished along more purely basic research lines. To have been completed by June, 1963, construction may now be called off if the development of beryllium-clad fuel elements does not pan out.

"Initiation of the Improved Cycle Boiling Water Reactor," in which the Commission selected the proposal of Los Angeles and Pasadena, Calif., is questionable. The municipalities have now decided not to participate in the 50-Mw prototype reactor project after the Commission's Advisory Committee on Reactor Safeguards turned down approval of the proposed Haskell Canyon site for future installation of larger nuclear units. However, an Anadarko, Okla., cooperative may be interested in the project.

Seven municipal and cooperative utilities have expressed interest in building a 50-Mw prototype organic-moderated reactor being designed by Atomics International for AEC. AEC has said it would build the prototype alone if no cooperative offers were received. The original deadline of May 2 ran out before proposals were received, but AEC is now evaluating the new proposals.

Some reports are that the proposal comes from cities and others, and that 14 Vermont and New Hampshire public utilities would be linked to the generating station. It would be a prototype for a 300-Mw unit.

Set-back of the Philadelphia Electric Co's high-temperature gas-cooled reactor at Peach Bottom, Pa., was because of a refusal by ACRS to sanction the Peach Bottom site as "satisfactory for a reactor of this general design and power level." The report said, "This ACRS action probably will result in some delay in issuance of a construction permit and could result in delaying the project schedule."

SL-1 Accident Still Not Explained

The Board of Investigation just-released interim report on the Idaho SL-1 nuclear reactor explosion of Jan. 3 establishes upward motion of the central reactor control-rod as the most plausible immediate cause of the accident.

The Board sees no evidence as yet to support any other theory on the cause of the flash nuclear chain reaction. The inadvertent uranium fissions, the report found, produced 50 Mw-sec of energy.

The non-final nature of the Board's findings was qualified within the report:

"At this time it is not possible to identify completely or with certainty the causes of the incident. The most likely immediate cause of the explosion appears to have been a nuclear excursion resulting from motion of the central control rod."

The report noted that the job of the three military operators to reassemble the control rod drives involved lifting the central poison blade a maximum of 4 in. But it was also established rather anonymously that to produce criticality the central control rod would have had to be lifted 16 in. upwards. All three men had performed the same task at least four times before the fatal occasion and had training in the technique.

News Scope

INTERTIE—Pacific Power & Light and Portland General Electric will get together to construct a $25-million, double-circuit, 230-kv transmission line to feed power from Grant County PUD's Wanapum Dam project directly into the two systems. The 200-mile line will connect Portland and PP&L's Yakima, Wash., service areas with Wanapum and will also tie into PP&L's Lewis River generating system. The two utilities have contracted for 500 Mw of Wanapum output.

RIGHT-TO-VOTE BILL DIES—Washington State House of Representatives sent a controversial right-to-vote power bill back to the Rules Committee where it is expected to die. The bill sought to prohibit PUD's from condemning facilities of investor-owned utilities without a public vote. Opponents argued that public power is not allowed to spend public funds in an election campaign while investor-owned companies would have unlimited resources to throw into the battle. After four days of filibustering and appeals from Democratic party leadership, the bill was sent to committee by a 51-47 vote.

FLOOD DAMAGE—Spot check indicates electric utilities kept their feet dry during floods which washed the Southeastern states. Alabama Power reported damage to its Jordan Dam-West Montgomery 110-kv line. Less than 400 customers were disconnected in hard hit Tuscaloosa and Montgomery when buildings were flooded, but service was restored as soon as flood waters began falling. West Point Light & Water Department of West Point, Ga., was standing by with amphibious vehicles and portable generators, but never had to use them.

REYNOLDS STILL OPERATING—A compromise involving the Southwestern Power Administration, the Arkansas Power & Light Co, and the Reynolds Metals Co has made it possible for Reynolds to continue operating its alumina plant at Arkadelphia, Arkansas. Reynolds planned to close the plant because reduced operating rate couldn't support the cost of electricity. Governor Orval E. Faubus got the three sides together in Little Rock where they agreed to let Reynolds buy less high-cost peak-power from SPA. Power is delivered over AP&L lines.

REACTOR PROJECT FIZZLES—AEC has announced official withdrawal from the cooperative reactor project with the municipalities of Los Angeles and Pasadena. The statement said, "The Commission is now considering alternative courses of action for the project."

Dateline . . . Dallas (*Continued from page* 5)

them to respond with cascades of applause. In Dallas, he satisfied himself with but a single burst of applause in the course of his speech and a rising ovation afterward. The speech was written that way. It was not a lack of appreciation on the part of his listeners for they sat in rapt attentiveness.

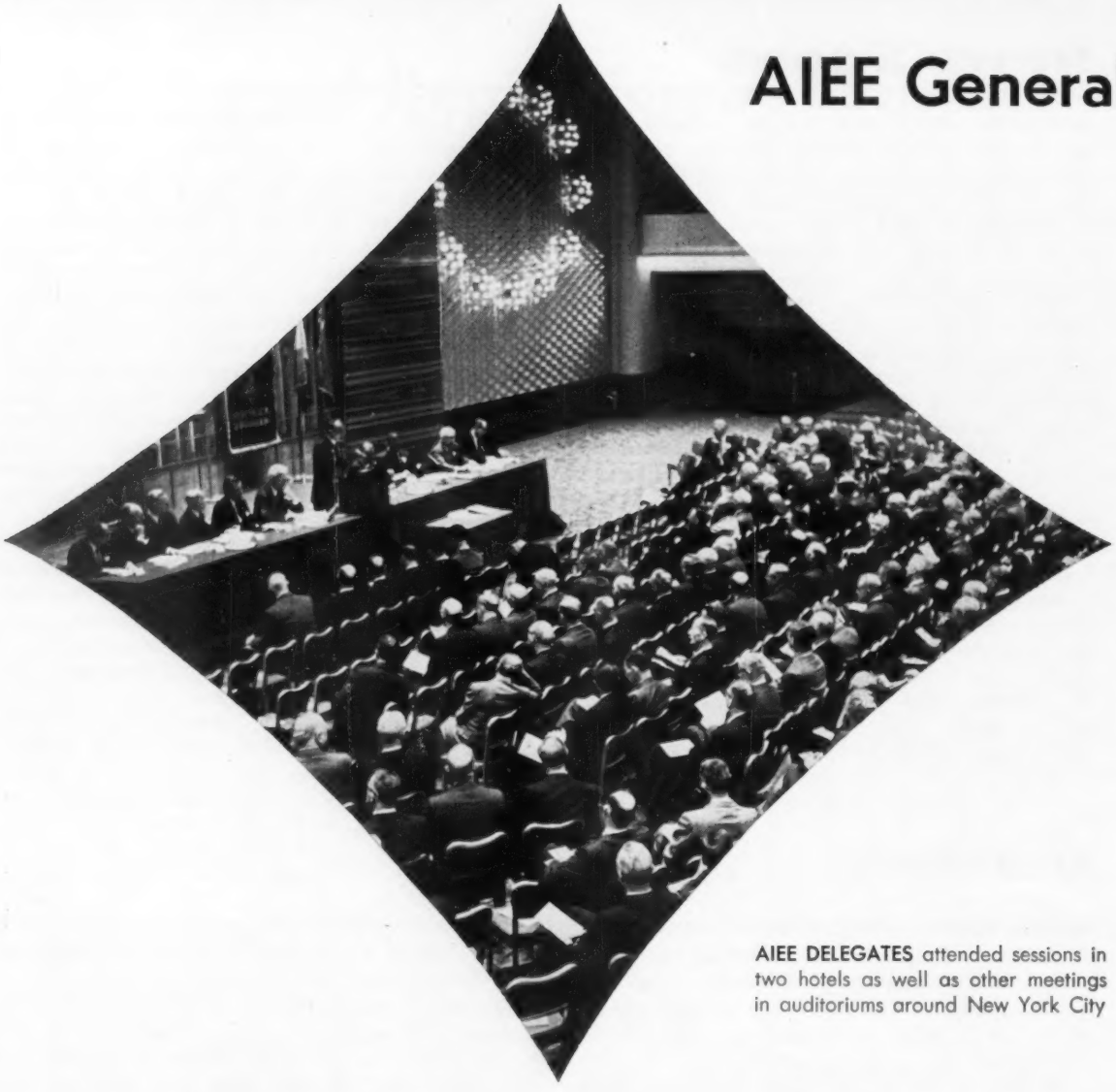
Probably of just as much significance was the very noticeable changes in the terminology of the speeches —Ellis' and others. It was difficult to discover a trace of the old catch-words—"the power trust," "the Wall Street boys," "the scheming, conniving fatcats," "the reactionary Congressmen," or (and this always delivered with a sneer) "the commercial power companies."

Instead, one heard the almost over-polite phrases —"the investor-owned companies," "the company executives," "our friends on the other side," "Congressmen who don't understand" or (and this delivered with almost no emotion) simply "the power companies."

There were still some whipping boys for the long parade of speakers to deal with, but the approbation was delivered more in sympathy than in anger. There were the investor companies who pirated territory and customers, but there were also municipalities that kept extending their city limits out into co-op territory. There was an administration which had let the farm areas become depressed and discouraged the family farm unit, but this was as much the fault of a tremendously progressive technology. There were still the outspoken opponents of the co-operative philosophy—the vested interests calling for higher interest rates on co-op loans, or some kind of federal tax on co-op earnings. But the most effective way to meet these opponents was with their own weapons—public opinion surveys to guide the way and full-page ads in the slick, consumer magazines.

For the Rip Van Winkle who was attending his first NRECA convention in nine years, it was this revelation of the Madison Avenue techniques of imagery that really took him aback. The elaborate screen presentation showing that more than half the city people either don't understand or disagree with favorable statements about the co-ops was a page right out of the books of the investor utility groups. The significant budget of pages in the slick magazines and the high-brow publications represented a media selection very similar to that of the power companies.

One can imagine that a decade ago those opinion surveys would have been laughed right out of an NRECA convention. Their very mention would have been as unthinkable and as out-of-place as a heckler rising to cast doubts on the reasoning of a William Jennings Bryant or a Billy Graham.



AIEE DELEGATES attended sessions in two hotels as well as other meetings in auditoriums around New York City

Computer Use in Planning, Operations

The digital computer is getting to be as handy an engineering tool as the slide rule, if impressions gained at the AIEE Winter General Meeting are correct. Nearly every session of interest to utility men featured some use of a computer or other automated equipment. The potentialities of this equipment were displayed in analyses of many varied problems.

Certainly the most immediately useful tool for applying digital computers to power system design and operation to be introduced at the Winter Meeting was a 210-page report listing scope and availability data on engineering programs in the power system field. It covers 75 different *types* of programs compiled by every utility with more than 75,000 customers. Key groupings cover transmission and distribution problems, system economics, structural analysis, transients, steam and hydro station design areas. However, there are no customer billing programs and only a few mathematical programs. The listing was compiled by the Computer Application Subcommittee of the AIEE System Engineering Committee. Price is $2.50.

A system of matrix formulas that, by successive application, permits reduction of power networks to a set of equations that can be programmed for digital solution, has been compiled in four papers by M. B. and G. B. Reed, Michigan State Univ, with J. L. McKinley, H. K. Polk, R. V. Hugo and W. J. Martin, Public Service Co of Colorado. Objective is to develop power system equations that provide "something better than B constants" and permit economic dispatch with an on-line digital computer. The first two papers of the four were presented at the Fall General Meeting. The final pair describe the digital computer program and the two basic theories on which the relationships are based. Key to deriva-

Meeting Stresses Automation

- Computers and automation dominated many sessions, even when not on the program; computer is acquiring status of standard utility engineer's tool (see below)
- Operating data from Leadville can be compared with that from Tidd to provide new insights into operating problems of EHV transmission (page 32)
- Distribution transformer loading practices and the sizes to be stocked focus attention on load growth patterns; service reliability also examined (page 34)
- How much capacity can you safely put in a single control room? Generating station designers are searching for an optimum figure for the future (page 37)
- Switching surges cut dielectric strength of cables more than was previously thought, tests disclose (page 38)
- Lightning surge effects require new evaluation of circuit breaker impulse testing; other switchgear standards are altered (page 65)
- Universal safety rules urged; present rules for high voltage equipment often not applicable to industrial and commercial installations (page 72)
- Automatic reclosing has proven successful in high-capacity substations, but further applications may be limited by fault current levels (page 74)

Featured in Many Sessions

tion of the node equations is a node transformation that permits the restoration technique leading to the final "daisy" equivalent of the system. Second element of the theory is the N-graph used during the development of the E-graph formulation.

The process involved convergence in two steps: on generators and on loads (with fewer loads than generators). Some discussers expressed doubt that the equations can be brought to convergence in application. After converging on generators and exploding back, it may be difficult, they felt, to converge successfully on loads because there are more load buses than generator buses.

Today's computers are mainly used for power system analysis to manipulate numerical information developed from interpretation of the system structure. H. W. Hale, Iowa State Univ, took the view in his paper that more of the steps involved in interpreting network structure should be done with computers. In two previous papers he described procedures for doing this by selecting a tree of variables of a network for analysis. In his current paper he presented a procedure for identifying all the trees of a graph.

A new method for simulating transmission line performance on a digital computer was described by J. G. Anderson, GE. With this method all direct lightning strokes that hit a line in a 20-year period can be simulated in 10 min.

The method is based on Monte Carlo techniques and provides a way of calculating line outages involving more variables than was previously possible. Such variables as the statistical distribution of lightning stroke currents, current wave time to crest, tower footing resistances, location of strokes, 60-cps phase angle, and shielding failures can be considered subject to such restraints as interactions between variables,

isokeraunic level, tower geometry, altitude, and line length.

W. S. Price of American Electric Power suggested that this may be the way-of-the-future to design transmission lines. It is an excellent example of applying modern statistical techniques to line design. He suggested that further field measurements were needed for inputs to the program.

'Elimination' Method Described

A new "elimination" method that makes load-flow studies in 10 to 20% of the time now required by iteration techniques was described by J. E. Van Ness, Northwestern Univ, and J. H. Griffin, General Motors. Recently programmed on an 8,000 words-of-storage computer for a system of 200 buses, it also will solve some problems which will not converge by iteration.

Glenn Stagg of American Electric Power Service Corp questioned the saving in computer time. AEP, he said, is making 60 to 70 load flows each week in one hour of IBM 7090 computer time.

F. M. Heck Jr, Potomac Edison Co, presented a unified mathematical development of the cost-of-capital based on fundamental concepts. The cost-of-capital is the rental (return), plus the tax paid to retain the rental (income tax), plus the cost of recovery of the capital (depreciation). It is commonly lumped with the cost of insurance and ad valorem taxes, and the entire group referred to as fixed charges. The correct treatment of depreciation was emphasized.

P. H. Jeynes, Public Service Electric & Gas Co, thoroughly agreed with the mathematical derivations and called the paper a comprehensive work for economic studies. However, C. W. Watchorn of Pennsylvania Power & Light Co emphasized that economic studies are mainly estimates of the future and aid judgment. He suggested that a reasonable range of conditions be studied and that intangibles often may determine system expansion.

An analog method to derive the optimum voltage profile for a power system and estimate the cost of varying from these optimum conditions was described by F. W. Smith, Portland General Electric Co. Studies on a small theoretical system indicate that significant savings can be made by optimizing the dispatch of reactive power.

Answering a question by L. K. Kirchmayer, GE, Smith said that this method had not yet been used on any system and therefore no savings have yet been realized.

C. J. Baldwin, Westinghouse, described techniques which are used to make mathematical models for simulating power systems. Questions such as how are random numbers generated by computers, how are a sequence of generator outage durations manually generated by Monte Carlo, and how are load deviations represented using Markov chains were considered.

For example, a sequence of outage durations may be generated manually by Monte Carlo as follows: Load a hat with 100 numbered slips. The probability of drawing a number between 1 and 75 is 0.75 and represents a one-day outage duration. Similarly, a number from 76 to 100, representing a two-day outage, has a probability of 0.25. Repetitive drawings will produce a random sequence of outages which must be separated from each other by random sequences of on-times and scheduled outages generated in similar fashion.

Analog computers are being used for studies of dynamic performance of control systems, of surge voltage phenomena, and of equipment components (towers), and are not passing out of the picture, according to C. Concordia, GE. The electronic differential analyzer is actively used in studies of generator voltage regulator and excitation systems, and the study of turbine, boiler and furnace dynamic performance.

The transient network analyzer is used for studies of switching and lightning surge voltages and abnormal voltages caused by such phenomena as ferroresonance. The small-scale model is used to represent the dynamic characteristics of large apparatus. Such models have to be used to study surge characteristics of line and tower design to improve lightning performance.

The transient network analyzer may be classified as lying between the electronic differential analyzer (for which mathematical equations for the system to be simulated are needed) and the scale model (for which only a dimensional analysis of the system is needed).

EHV Operating

The latest summation of Leadville 345-kv tests—undertaken to weigh the effects of altitude and uncontaminated atmosphere on corona and RI performance of EHV lines—were contained in a group of four papers by 17 authors. They covered testing, corona loss studies, radio influence investigations and tests of towers, conductors, insulators and substations.

One highly significant finding at Leadville was the absence of conductor aging and corona loss reduction with time, previously experienced in Tidd's more contaminated atmosphere. Corona loss was practically constant at around 90 kw per single-phase mile, a considerably higher level than at Tidd. Moreover, corona loss was well below that given by Peek and Petersen.

From the RI standpoint conductor sizes now used for 230 kv at sea level can be used for 345 kv at high altitudes. For instance—2.92 in. above 300 kv, 1.65 in. at 345 kv, and twin 1.4 in. at 400 kv. Scant foul weather data was taken on corona loss but enough to suggest a sharp increase over fair conditions. Changes in barometric pressure are uncommon at Leadville's high elevation. The effect of altitude on radio influence 200 ft out from the line can be approximated by the square root of the relative air density. Corona starting gradient averaged about 15.6 kv per cm at Leadville's altitude vs 18 kv per cm at Tidd (sea level). Corrected to standard conditions there was little difference.

Simple Structures Preferred

Structural experience at Leadville showed the wisdom of using simple structures with few parts where altitude is high and working conditions difficult. No aolian vibration was experienced and vibration performance of all spacers was good. Ice accumulation up to ¼ in. on the four-conductor bundles was experienced, resulting in substantial mechanical loading. It was found that EHV wood-crossarm towers could operate with insulators unbonded and ungrounded.

Details of 18 steel, aluminum, laminated-wood and pre-stressed

Data Revealed

concrete transmission towers, installed at Project EHV to correlate tower and conductor with weather conditions, were also analyzed in two papers. All but two of the towers were of steel or aluminum and designed by five organizations to obtain design diversity.

Steel and aluminum tower features were discussed in a paper by S. D. Alpert, Stone & Webster; J. H. Foote, Commonwealth Associates; G. E. Fortney, US Steel; H. B. White, Aluminum Co of Canada; D. D. MacCarthy, GE; and J. E. Williams, Aluminum Co of America.

Two of these towers designs use aluminum. One is a free-standing tangent structure, conventional in contour, unique for its use of Y-shaped corner posts and crossarm members as well as tubular redundant members. The other aluminum tower is a guyed V-type with lattice masts and a single footing having two guys per mast.

The steel towers, of conventional contours, have square, rectangular and narrow bases and use both A-7 structural steel and high-strength, low-alloy stainless steel. Towers were supported on special driven pile foundations at several locations where water was above the ground surface. But in the core of portal structures, where soil was loose and sandy, explosive compaction was used to avoid use of piles.

The two non-metallic structures are of pre-stressed concrete and laminated wood and are unique in transmission practices. Their features were described in a paper by S. D. Alpert, Stone & Webster; M. Schupack, Schupack & Zollman; J. J. LaForest, GE; and R. W. Stumbo, Rilco Laminated Products, Inc. The 110-ft laminated wood tower weighs 26 tons and is a cross-braced H-frame with columns consisting of H-sections built up of glued 2x8-in. timbers. Leakage currents in the area of the conductors are directed to ground by ¾-in. tubular aluminum leads at the four corners of each column. Hardware is grounded to these leads which also shield the tower and insure good RI performance when the wood is wet.

The 100-ft pre-stressed concrete H-frame is self-supporting and although it weighs 66 tons it is supported above grade on driven piles. The slightly-bowed cross beam of the tower and its two 94-ft vertical columns are hollow box girders 36x18-in. in section with 5-in. walls. Presence of tensioned cables in walls of these members accounts for the low field in the area of the conductors and is an advantage of the design. Other features are its low maintenance and high strength.

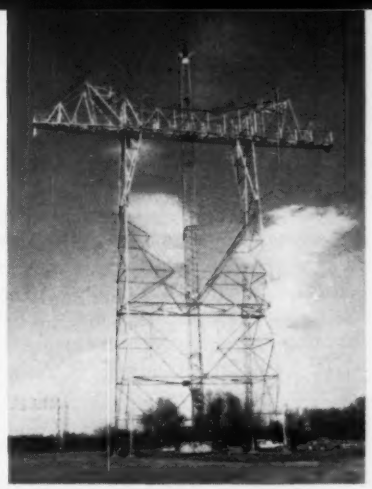
Design features of the 650-kv substation at Project EHV were given by P. A. Abetti and A. H. Powell, GE, with co-authors R. E. Larson, Alcoa, and M. D. Robinson, Stone & Webster. Since its initial operation, performance of the North Substation has been satisfactory. Present operation is at the 483-kv level, but it has operated at voltages from 460 to 550 kv and has been tested at 720 kv.

Conducted RIV Measured

Conducted RIV has been measured at 388 μv, well within the maximum design limit of 500 μv. Line switching surge strength was based on surges of 2.4 to 2.5 times line-to-neutral crest voltage. Switching surge withstand level of the 40-Mva transformer was set at 80% of the impulse BIL. Minimum transformer insulation margins over lightning arrester voltages were set at 20% for impulse, 15% for switching surges.

Impulse BIL of the high-voltage transformer winding is 1,925 kv or about three steps down. Apparatus on the high-voltage bus was assigned a BIL of 2,000 kv or 30% above the 1,560-kv arresters located at the transformer. Critical switching surge strength of bus insulation is about 21% higher than arrester sparkover at 1,277 kv.

Longer bus supports than the 13 pedestal stacks 15.8 ft high would have been preferred but would have sacrificed mechanical strength, already taxed by the weight of experimental apparatus. As it is, dry flashover strength of the high voltage bus insulation is about the same as that of 650-kv line insulation, or 2,400 kv.



ALUMINUM TOWER on Project EHV line is an example of new designs in use

Laboratory tests reported by R. W. Harmon, Ohio Brass, suggest that control rings are not necessary at 650 kv on 3 and 4-conductor bundles with special suspension assemblies. Short-coupled suspension assemblies, he explained, bring the insulators as low as possible with respect to the conductors. Substantial savings can result, because right-of-way widths can be reduced and smaller towers used. However, twin-conductor 460-kv suspension insulator assemblies will probably require control rings, Harmon observed.

J. R. Leslie and J. Reichman of Ontario Hydro said that their tests showed more corona and RIV for similar conditions than Harmon reported. But they concluded that RIV and corona are not serious up to 650 kv.

P. L. Bellaschi, Portland, Ore., consultant, stressed the importance of voltage distribution across insulator units and the function of grading shields in relieving the voltage stresses. More experimental data are needed, he said, on voltage distribution across insulator units with and without grading shields, single and bundle conductors, and both suspension and V-string assemblies.

Results of switching surge tests at Project EHV plus wet and dry impulse and 60-cps tests on a large variety of insulators and air gaps were described by A. F. Rohlfs, H. E. Fiegel and J. G. Anderson, GE. Two significant conclusions have been made:

• Simple extrapolation of spacings from lower voltage systems is not advisable because of unusual

flashover effects.

• No fundamental flashover limitations for line and station insulation have appeared in the tests.

Sharp issue was taken with recommended wind and ice loading assumptions of the 4th and 5th editions of the National Electric Safety Code in two papers by AEP Service Corp transmission engineers.

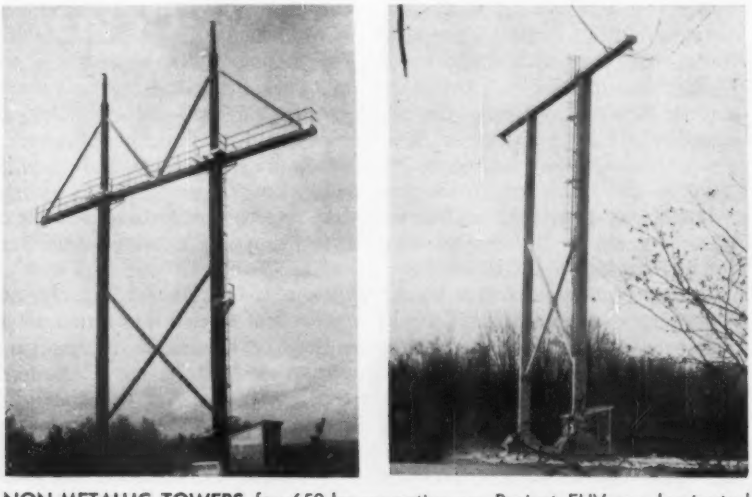
R. L. Retallack and E. S. Zobel in their paper pointed out that intent of the NESC wind loads is that heavy loading is greater than medium, which in turn is greater than light loading. But they observed that this is not true of the 4th edition for 1.0-in. conductor and larger. Nor is it true of the 5th edition for 0.4-in. conductor and larger. These inconsistencies stem from the NESC requirement that wind and ice loads be considered to occur simultaneously. To correct the situation for their system, the AEP engineers have compiled supplementary requirements based on wind and ice loads occurring at different times. These requirements are about equal to the 4th edition's for large conductors and the 5th edition's for small ones.

Arthur Price, Ebasco, suggested, in discussion, that usefulness of the code would be increased by a change to bring it in line with realities of present conductor sizes. H. H. Rodee, Alcoa, conceded the remote chance of simultaneous ice and wind and suggested that wind loading should be the same in all areas except for special conditions. R. W. Caswell, Commonwealth Edison, said a change in the code, however desirable, should not be permitted to affect crossing requirements; these are already severe enough.

A 2.8-mile all-aluminum transmission tower line traversing an area of Philadelphia conspicuous for its corrosive atmospheric conditions was described by A. H. Sellers of Philadelphia Electric and J. E. Williams of Alcoa. Designed for two 220-kv circuits, the towers were sub-assembled on the ground in sections and panels and raised with crane or gin poles.

In erection, torque wrenches were used to avoid breaking the aluminum bolts. Moreover, the greater deflection of aluminum tower members under load caused errors in sag until the reason was understood and stringing precautions taken.

Heavy salt contamination on insulators and bushings is a serious problem in Japan, because large thermal plants with 161 or 287-kv transmission are now under construction near the sea coast, noted M. Yamamoto and K. Ohashi, Tokyo Shibaura Electric Co. Over-insulation of equipment is impractical, and spray and jet nozzles have been used to wash insulators, sometimes on a daily schedule. Tests confirm that silicone compound treatment produces excellent anti-contamination qualities with good durability and has been recommended for use hereafter.



NON-METALLIC TOWERS for 650-kv operation on Project EHV use laminated wood (left) and prestressed concrete (right) as basic materials of construction

Distribution

New advances in the endless campaign to resolve distribution's complex economic and service reliability problems were revealed in several sessions. Many of the papers presented new computer programs or analyzed system data to deduce indices for system design and operation. And the distribution transformer came into focus as a center about which much of the material revolves.

Distribution transformers should be sized for original installation so that no more than one replacement will be required for load growth, advised D. C. Achtenberg, Detroit Edison Co, in a paper co-authored by A. E. Piper. If they are selected to serve demands expected within five years, the extra capacity has not been installed too early. The transformer's growth curve usually flattens within this period and does not change subsequently unless the character of its service area changes, he said. (See graph, page 36.)

This concept of loading practice was developed from analysis of kwhr use and 30-min demand recorded continuously since 1949 on 13 distribution transformers selected as typical installations. These transformers serve about 400 customers in urban and suburban areas. One typical installation, a 25-kva unit serving 39 homes in 1949, has experienced 20% growth in connected customers and nearly 80% growth in total kwhr. But the peak demand has climbed more slowly, from 23 kw in 1950 to 33 kw after ten years, and is expected to level off before transformer replacement is required, said Achtenberg.

Base Economies on Load Growth

Studies of transformer economics must be based upon load growth impressed upon transformers in service. This usually occurs largely in the first few years and is followed by a long period of slow or negligible growth. Thus the compound growth curve is not a true index of distribution transformer loading, no matter how well it represents overall industry growth, he concluded.

Such a load growth pattern apparently could be represented in a new digital computer program pro-

Transformer Loading Discussed

posed by J. A. Hughes, Commonwealth Edison, in a paper coauthored by R. P. Burandt of that company and A. D. Patton and D. N. Reps of Westinghouse. This program, while primarily planned to optimize transformer-secondary designs, can also determine:

1. The effect of design modifications on costs.

2. The economic initial and ultimate loading of transformers.

3. The economical number of transformer changeouts and whether any standard rating should be dropped.

4. The economic choice of secondary size or sizes.

5. The effect of voltage restrictions on design practice.

6. The effect of changes in transformer regulation or losses on customer service cost.

Provide Growth Options

The program accepts transformer loading as "the best and most easily monitored measure of system performance and the controlling design limit," said Hughes. It provides an option of linear growth or compound growth but sets a limit of double initial load or a 25-year growth period to reflect probable saturation in residential area load. And it prints out economic choices for transformer-secondary combinations which satisfy thermal and voltage limitations to achieve the lowest annual revenue requirements for investment, operation, maintenance, and losses.

Transformer-secondary combinations were handled in somewhat different manner by M. W. Gangel and R. C. Ender, both General Electric. Their program evaluates separately the voltage drop caused by in-phase and quadrature components of load and applies secondary capacitors as one of several methods for meeting voltage-drop limitations.

In discussion one reviewer urged modification to include secondary banking as a cure for voltage flicker. And H. F. Ostman, Union Electric, stressed the need for extensive customer load research to attain savings in system expansion.

Both the energy loss and the peak loss must be considered simultaneously in determining the economic locations of shunt capacitors. This is the basis for computer programs which were claimed by R. F. Cook, Westinghouse, to specify the ratings, number of installations, locations, and relative amounts of fixed and shunt capacitors for any distribution circuit. Other axioms revealed by his analysis are these:

1. The location for maximum energy-loss reduction is where capacitor current is half the feeder's average quadrature current.

2. The location for maximum peak-loss reduction is where capacitor current is half the feeder's maximum quadrature current.

3. If two or more capacitors are used on a feeder, they should be similar in rating.

Feeders at 12 or 13 kv can provide customer service comparable in reliability to 4-kv distribution with extensive use of reclosers, sectionalizers and fuses, reported J. E. McNabb, Westinghouse. He finds fuses least expensive in first cost, but subject to additional expenditure and customer interruptions when they operate for a temporary fault and capable of complete coordination only for load densities below 2,600 kva per sq mile. Sectionalizers overcome these difficulties for under $0.50 per kva wherever substation breakers can reach faults at the ends of laterals. And reclosers offer the ultimate in protection for about $3.00 per kva, he said.

The location of the sectionalizing devices is an important consideration. Very little improvement is secured by putting them in the main, he stated, as a maximum installation could only halve the customer interruptions. Instead he favors sectionalizing the laterals where they take off from mains, for which he finds a possibility of cutting interruptions in proportion to the number of sectionalizing devices to an ultimate of one-tenth the non-sectionalized rate. In general, the greatest improvement in feeder reliability is achieved by sectionalizing the longest laterals, he concluded.

Use of 150-kv BIL equipment for 20/34.5-kv operation permits the economical connection of spot loads as low as 150 kw directly to the 34.5-kv system to release 4 or 12-kv distribution capacity, said R. H. Sarikas, Illinois Power Co. Properly designed 34.5-kv lines would compare favorably in appearance with 12-kv lines, he said, but would require slightly more conductor spacing and tree trimming. Protection would be provided with 27-kv distribution-class lightning arresters and cutouts, with a sufficient number of single-phase distribution transformers connected to each phase to defeat possible ferro-resonance when one fuse operates.

A recently designed utilization transformer for installation right at the customer's building is the key feature of an underground distribution system installed by Iowa Power & Light Co, said H. G. Hally. Presenting a paper on the system and a companion paper on the transformer, Hally noted that the scheme, which permits utility ownership of equipment right up to point of attachment to the residence, is comparable economically to equivalent underground systems and will eliminate problems which other arrangements may foster.

Hally noted that the home owner will remain the utility's customer long after any special arrangement with a builder has been forgotten, and the home owner will expect the same service responsibility that has been provided with overhead service.

Underground Substation Described

Quebec Hydro's 240-Mva Dorchester Substation in downtown Quebec, forced underground by site limitations, was described in a paper by four authors. P. L. Ward, Canadian GE, L. D'Auteuil, J. Pauze and A. Gaudette, Quebec Hydro, called attention to the use of transformer losses to heat Quebec Hydro's adjacent office building.

Built 53 ft under a city park at a cost of $6 million, the five-level substation covers a 250x200-ft area. The substation's six 40-Mva oil-filled transformers are supplied at 120 kv and step power down to 12

kv for distribution of 24 cables to major customers. An additional 15 transformers of 10-Mva capacity regulate and reduce voltage for 60 4-kv outgoing distribution feeder circuits.

Heat losses from transformers are channeled through conversion units to the Commission's office building. Excess heat can be exhausted to the outside when necessary.

With substation sites growing harder to find, buy, and develop, it is necessary to lay down some guide lines for selecting them, said W. A. Conklin, Consumers Power Co. His paper called for location of substations and transmission line on highways adjacent to commercial property and provisions of ample land for future substation sites and rights-of-way.

Sites should be selected to ease line exit, but use of exit poles should be kept down. Also, sites should be picked so that substation structures can be set back from the property line.

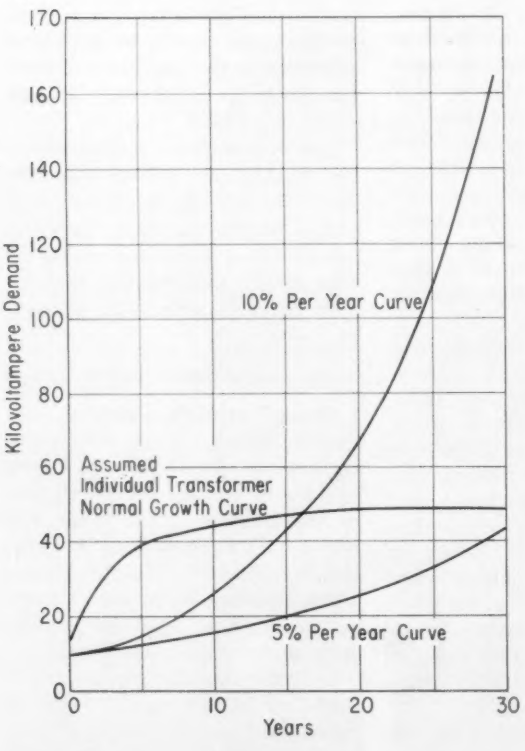
A procedure for detecting incipient faults in transformers by gas analysis was outlined by P. S. Pugh, American Electric Power Service Corp, and H. H. Wagner, McGraw-Edison Co. A portable detector has been developed which indicates the total percent of fault-produced combustible gases present in the transformer gas space. Gas samples are taken without de-energizing or disturbing the operation of the transformer in any way.

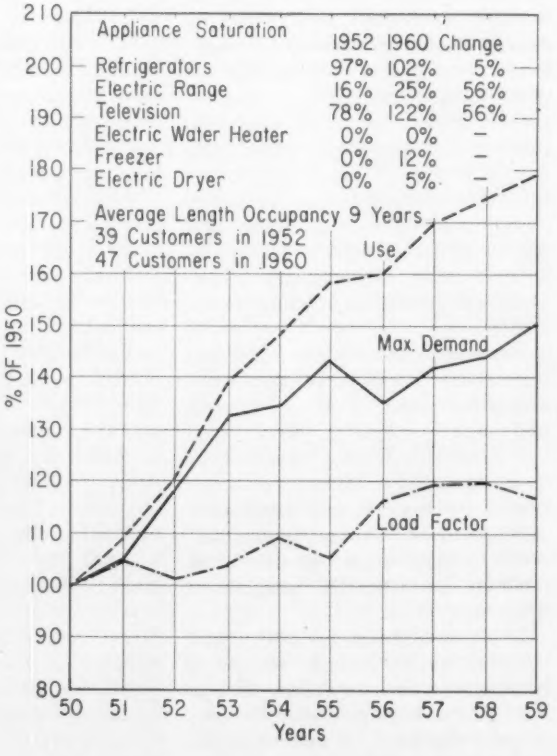
Detector Needed in Past

The need for a detector has been recognized for many years, and failures of large power transformers in this country and Europe in recent years "have caused growing concern," the authors reported. Incipient faults cause local heating which decomposes solid insulation and oil with consequent liberation of some 16 different gases, analysis of which will indicate that an incipient fault exists in the power transformers.

Until a guide for uprated transformers is developed and accepted by the industry, it appears desirable to establish a loading procedure for higher temperature transformers based on the present ASA C57.92 loading guide, maintained J. H. Carpenter and C. W. Hiers, GE. The authors noted that several new transformer electrical insulating materials now available have been developed for temperature characteristics not recognized by the guide.

The most important factors which must be considered in thermally uprating transformers include hottest-spot temperature during continuous operation with normal life expectancy, hottest-spot temperature during short-time loading with moderate sacrifice of life, maximum oil temperature and uprating component parts of the transformers, they said.





DISTRIBUTION TRANSFORMER LOADING is better represented by sharp early rise followed by prolonged plateau than by compound growth curves. Characteristic is confirmed (right) by tests on a residential Detroit installation

Capacity Concentration Guides Control Room Design

Today's concern with power plant automation ran all through generation discussions at the Winter Meeting. It cropped up in sessions on control room design and was basic to the discussion of automatic synchronization of cross-compound turbine-generators.

Although there was feeling that automation may someday radically change the face of control rooms, the biggest thing affecting today's control room design is the growing concentration of capacity in a single room. Concentrations ranging from four 165-Mw units to one 325-Mw unit were cited. Station manning tables suggest a decrease in kw per man per shift with fewer units in one control room, but the trend is spotty at best.

At Potomac Electric Power's Dickerson Station controls for two 350-Mw units are centralized in one room. A saving in manpower for two-unit operation and elimination of communication problems during starting were cited in a paper by C. W. Schmitz and C. S. Bilisoly. The present complement is five men per shift for two 350-Mw units.

One Room Controls 660 Mw

Largest concentration of units found practical to control at one point on the Pacific Gas & Electric System is at Pittsburg Power Plant where four 165-Mw units (660 Mw) are controlled from one room. Two new 330-Mw units for Pittsburg will be controlled from a second control room, E. Nilsson and G. A. Abbott reported in their paper. This new room will incorporate a unique benchboard that is a combination control and vertical instrument switchboard.

Control room features for the latest 325-Mw units at Detroit Edison's St. Clair Station were reported by J. L. Voyles and R. C. Austin. There will be separate control rooms for each 325-Mw unit. And as at PG&E a new combination benchboard and vertical instrument panel will increase "right angle" viewing of instruments and increase the accessibility of controls.

Concentration of two 325-Mw units in one control room risked loss of 20% of system capacity in the event of a mishap affecting the room, the author said.

Such a "mishap" at Con Edison's East River Station resulted in a fire in control cables and has led the company to revise control cable practice, John Noest said in discussion.

All control cable now is flame proof. Control board sections are isolated and Fiberglas fire stops used at 10-ft intervals in the enclosed trays and at openings into buses.

Problems associated with automatic synchronizing of cross-compound turbine-generators on turning gears occupied a second generation session. A digital computer program that calculates machine performance during synchronization on turning gear was described by C. M. Lane and T. H. Kuo of Westinghouse. In a companion paper C. M. Lane, Westinghouse, and P. Barth, Public Service E&G, presented field test verification of the analytical method based on tests at Public Service E&G. They found that the electrical angle between rotors at the instant of excitation is just as important as the rate of application of excitation voltage and also that the optimum angle between rotors is close to zero. Moreover, for smooth synchronization, excitation voltage level should be near 60-65 v.

L. T. Rosenberg, Allis-Chalmers, confirmed the Westinghouse conclusions on the basis of two tests on 327 and 275-Mw units with 1,800-rpm LP turbines.

Devices that facilitate automatic synchronization on turning gear were described by J. D. Davidson, Westinghouse. They comprise a sensing device that detects and indicates when turbine shafts are in proper angular relationship for synchronizing. Also a system insures that rotor-angle difference will be big enough, when excitation is applied, to let field current build up by the time rotors are in phase.

The theory of turning gear synchronization developed in a paper by P. E. Benner and L. R. Stuver, GE, showed that synchronizing torque is generally enough to hold generators in synchronism. However, when a single motor-driven exciter supplies both fields of a cross-compound set, a two-speed turning gear motor (3 and 9 rpm) should be supplied. Tests at AEP's Breed Station showed a 15-fold increase in synchronizing torque in going from 3 to 9 rpm turning gear speed. Synchronizing torque is sufficient on the high-speed connection to drive both HP and LP shafts from one turning gear. Moreover, they said that two generators can be synchronized on turning gear without a shaft position indicator by turning the LP turbine shaft at low speed and the HP turbine shaft at high speed and applying excitation to both simultaneously. The HP rotor will then pull the LP rotor into synchronism.

P. E. Benner pointed out in discussion that synchronization on turning gear is not necessary for successful starting. By-passing steam to the LP turbine and starting both HP and LP with steam is also practical, he said.

Static System Practical

A completely static excitation system, rated 90 kw, 250 v, and installed on a 25.6-Mva, 13.8-kv generator, was described by L. M. Domeratzky, A. S. Rubenstein, and M. Temoshok, General Electric. This system can be used for generators up to 133 Mva. Potentially more reliable than a rotating system, it has the advantage of decreasing over-all length.

In discussion, P. O. Bobo, Westinghouse, said that his company has applied static excitation systems to generators up to 2,500 kva. Computer analysis shows no reason why this system cannot be extended to bigger generators, he said.

A simulator for testing transient characteristics of a synchronous machine with a regulator was described in a paper by Colin Adamson, England, and A. M. El-Serafi, Egypt. This simulator is unique in that it operates as an integral part of a network analyzer and so may be used to observe the effects of a change in synchronous machine regulation on a power system.

An amplidyne excitation system for the largest generators anticipated in the near future has been developed by GE, according to L. M.

Harvey, A. S. Rubenstein and M. Temoshok. This system requires much less control power, can be adapted easily to special requirements, and gives high exciter voltage response.

However, C. F. Paulus, Cleveland Electric Illuminating Co, questioned the high commutation requirements and increased carbon brush dust of this equipment. He suggested that these make the insulation problem difficult. Paul Dandeno, Ontario Hydro, asked if this excitation system can be applied to hydro machines. He also questioned the need for high exciter response.

Temoshok replied that 3½ years experience has shown that the aerodynamic arrangement easily gets rid of dust. Moreover, it can be applied to hydro machines. And the need for high exciter response is dependent on the power system and requires a system study, he added.

An equivalent circuit, though simpler, accurately describes the electrical characteristics of a commercial precipitator installation, J. W. Drenning, Koppers Co, told the AIEE Electronics Committee. Drenning, along with J. B. Thomas, Princeton University, and H. T. Williams, also Koppers Co, presented a description of an equivalent circuit.

This circuit, appropriately scaled, accurately simulates, with conventional laboratory equipment, the large, inflexible, and complex circuit, he said. This analog can be adjusted to simulate changes in precipitator operating conditions and equipment and provides a technique useful in design development and testing.

R. G. Ramsdell Jr, Consolidated Edison Co of New York, described precipitator collection efficiency, or the amount of useful "corona" power, as a function of the number of active high-tension electrical bus sections into which a precipitator is divided. Each bus, he said, must be backed up by adequate transformer-rectifier sets.

Ramsdell pointed out that this quick method of determining probable collection efficiency has proved useful to Con Edison in purchasing new dust collecting equipment and in revaluating the collecting equipment on hand.

Switching Surges Cut Cable Dielectric Strength

Three papers from Europe and one from Canada dominated the cable sessions. Signori P. Gazzana-Priaroggia and G. Palandri of Pirelli S.p.A., Italy, revealed test results that showed the dielectric strength of oil-filled and pre-impregnated, gas-filled high-voltage cables is 7 to 20% lower under switching surges than under 1/50-μsec impulses conventionally applied in cable tests. Tests with damped oscillations superposed on steady-state 50 cps and without the 50-cps voltage revealed that the power-frequency component's influence on the dielectric strength was practically nil.

The tests did not cover recurrent transients, though the authors recognized that these may cause a fatigue effect in the dielectric. They also brought out the difficulty of testing cable for its behavior under normal working stresses "because no test having the characteristics of briefness can replace the action of a continuously applied stress for 20 years or longer." They added that "in general, the shorter the test, the less reliable the answer."

Some disagreement was offered by England's C. C. Barnes of the Central Electricity Authority and C. T. W. Sutton, Enfield-Standard Power Cables, who stated that for load-cycle testing "experience has shown that with pressure-controlled dielectrics it is not necessary to have a large number of heat cycles as any instability will be revealed quickly." In discussion, Edward Eich of Anaconda Wire & Cable Co supported the Italians' view.

Existing Ducts Used

Utilization of existing 15-kv cable ducts for 115-kv cable needed to meet increased loads in Toronto saved 51% of the cost of alternative proposals, reported T. J. Burgess of the Hydro-Electric Power Commission of Ontario. The cable was aluminum-sheathed, single-conductor, 350-MCM, low-pressure, oil-filled, with stop joints and 12 oil reservoirs in its 3¼-mile length. The utility had been apprehensive before installation in 1956 that the aluminum sheath would suffer from corrosion, but in 4½ years experience there have been no troubles from this cause. Discussers pointed out that a 200-psi cable with a pumping plant at each end would have eliminated many of the low-pressure accessories and lowered the cost, but, in closure, S. Kozak, Canada Wire & Cable Co, pointed out that the high-pressure type was too new a concept when the design was laid out. C. E. Bishop of Ontario Hydro and K. Kuwahara of the cable manufacturer co-authored.

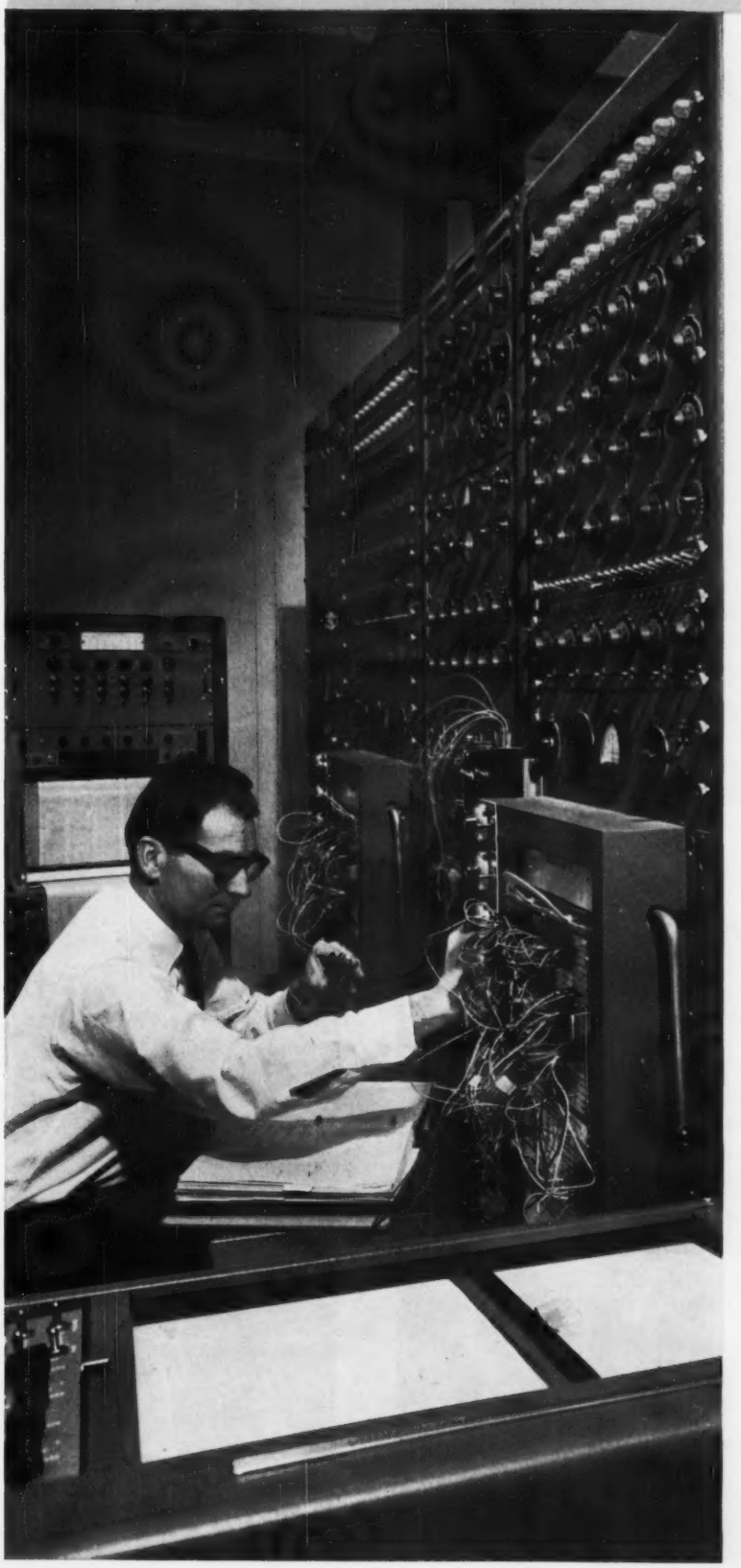
In the other overseas paper, J. S. Møllerhøj, Northern Cable & Wire Works, Denmark, pointed out the merits of flat-type oil-filled cables now in use to 170 kv and outlined techniques for laying flat submarine cable from a floating drum.

Butyl compounds for cable came out well in tests reviewed by three manufacturers. Its insulation value against tracking, carbonization and erosion was demonstrated by K. N. Mathes and E. J. McGowan, General Electric Co, and L. Mandelcorn, R. E. Hoff and G. R. Sprengling, Westinghouse Electric Corp.

The first two authors subjected samples of more than a dozen materials to ac potentials while allowing contaminants to flow over their surfaces. The other team passed electric discharges of controlled power densities (w per sq cm) through washers cut from a number of insulating materials. Seven of the materials of the two tests were basically the same. The third test was for water penetration into cable jackets made from more than a score of materials, two of which were tested in the other investigations. Temperature and test-times were varied for samples immersed

(*Continued on page* 65)

ANOTHER STEP AHEAD IN VOLTAGE REGULATION



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Reduced Regulator Bandwidths Increase System Earnings

General Electric voltage regulators provide three added benefits to distribution systems through bandwidth reduction . . . extra feeder length, capacity, and revenue! New General Electric computer studies now prove that *reduced regulator bandwidths are practical* and that they result in increased distribution system performance with *no sacrifice of regulator life.*

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Your General Electric regulator representative can show you the specific effects on regulator operation as bandwidths are reduced. He will show you how to determine if operations must be controlled . . . and if so, how to control them. Increase the return on your regulator investment, possibly with your existing equipment.

Take full advantage of the important benefits of General Electric ML-32 step regulators. Reduced bandwidths provide more *usable* kva on the line . . . permit increased loading of existing feeders. This easily attainable "power adder" can mean increased line length and capacity—important tools to reduce or defer investment. Reduced bandwidth settings make significant contributions to feeder revenue, too!

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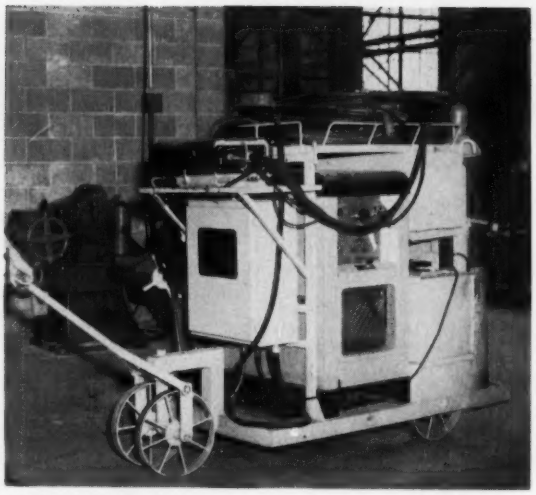
Cart Readily Moves Aluminum Welder

To facilitate moving the aluminum welding machine to various jobs around the shop, Georgia Power Co built a special cart. The welding equipment was purchased and mounted on the cart. Tools and materials are carried on the top.

The cart has a welded steel frame which is mounted on four heavy-duty wheelbarrow wheels. It is built along old stage coach lines with the front of the frame coming up over the two front wheels, although the cart itself is low-slung with the frame below the wheel centers.

The two front wheels are spaced close together to give the cart easy maneuverability. A tongue is used for pulling and guiding the cart.



A SPECIAL CART was built to facilitate moving aluminum welding machine from job-to-job in maintenance

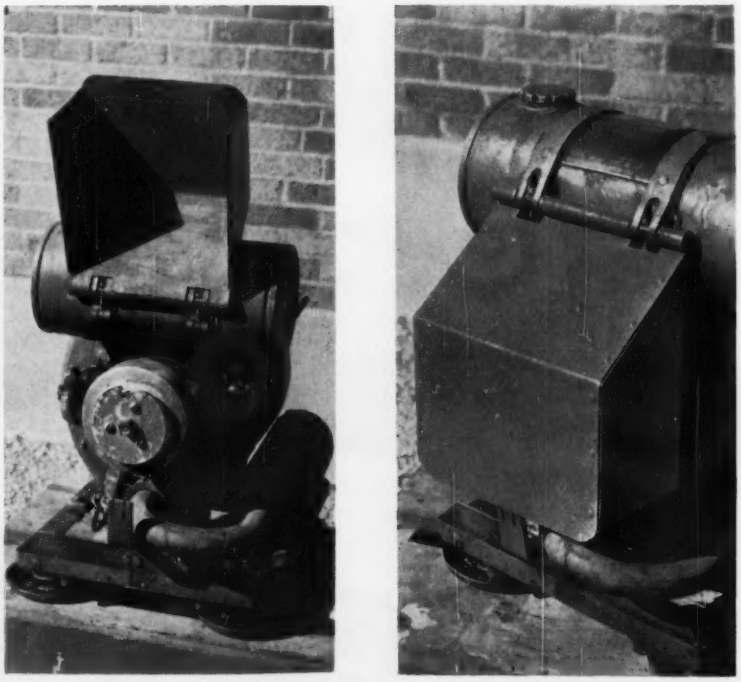
Safeguard Generator Flywheel

E. E. KNERR, maintenance man,
C. M. CRAWFORD, maintenance man,
Ohio Power Co, Crooksville, Ohio
—AEP System

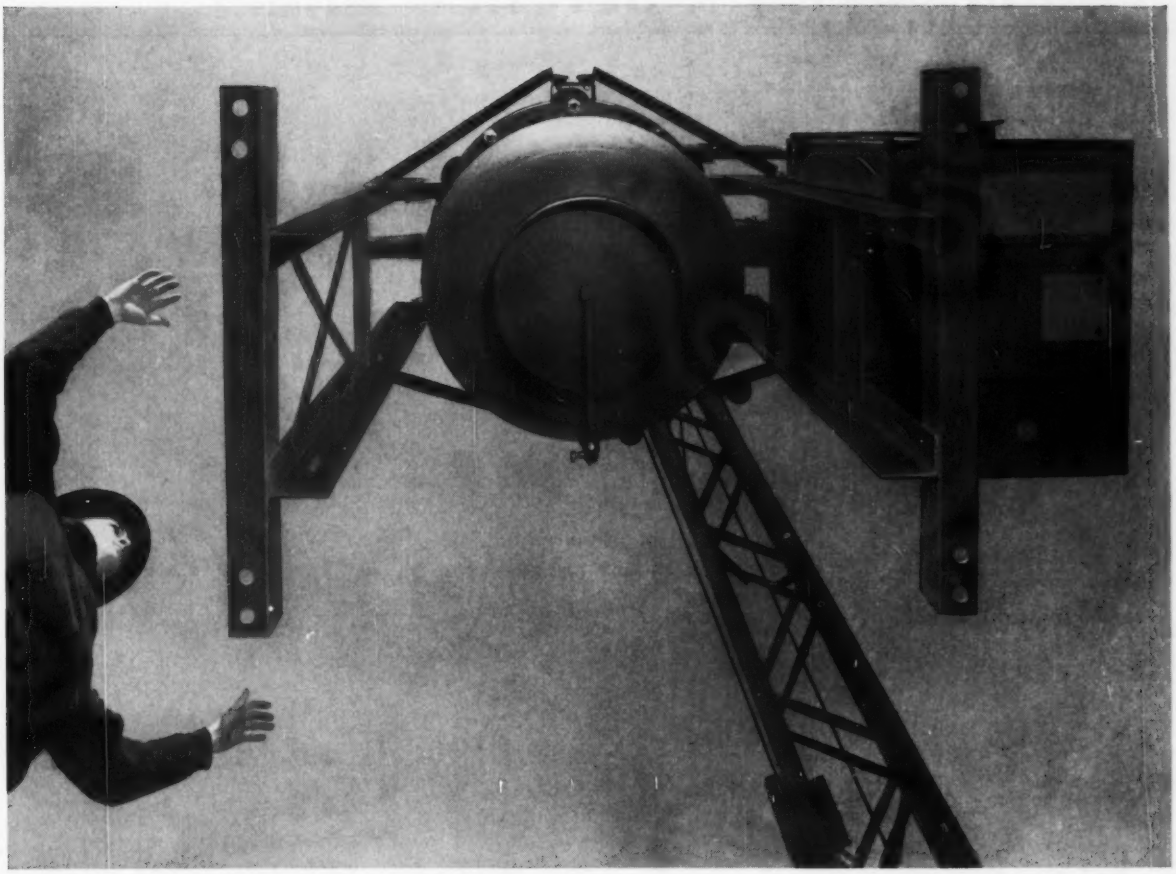
A sheet metal cover, job fabricated at Ohio Power Co, prevents accidental contact with the notched, spinning flywheel on a portable generator.

The cover is made from a sheet of 20-gage galvanized iron and has a spring to hold it open when starting the engine. As soon as engine has been started, the safety cover is lowered. It is shaped to enclose completely the flywheel.

The same idea, now one of our basic safety standards, can be applied to guarding other moving parts on machines.



SPRING-LOADED HINGE holds cover up during starting operation, but allows the cover to drop-close to safeguard personnel from the turning flywheel



From the foundation up— it's easy to see why one-tank breakers take less space

General Electric one-tank subtransmission breakers require up to 33 percent less space than comparable three-tank breakers. Reduced space requirements mean:

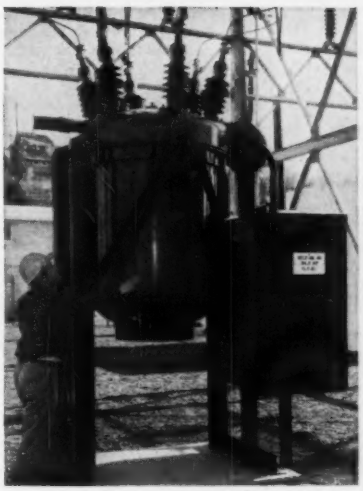
- You can make your next station more compact—or use the extra space for wider aisles and greater clearance;
- You save on excavation and materials for the foundation;
- You save on overhead buswork.

In addition, installation is faster.

G-E one-tank breakers arrive with all components in place, and there's only one tank to fill with insulating oil.

Lighter weight can mean reduced handling costs for you. One-tank breakers weigh 500 to 880 lbs. less than comparable three-tank breakers.

Ask your G-E Sales Engineer for more good reasons to use one-tank breakers. Section 493-06, General Electric Company, Schenectady 5, N. Y.



General Electric one-tank breakers are rated 14.4 through 46 kv, 500–1500 mva.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Select Power Loss-Voltage Drop For Uniform Feeder Load

R. A. DEWBERRY, Electrical Engineer, Montana-Dakota Utilities Co, Minneapolis, Minn.

Both power loss and voltage drop for a uniformly-loaded feeder for all common distribution voltages can be determined from a single chart. In addition, this chart will give the voltage drop at any specified point on a uniformly-loaded feeder.

For a uniformly-loaded 3-phase distribution feeder, the kva at any point x is:

$$\text{Kva}_x = \text{Kva}\ (1\text{-}x) \qquad (1)$$

where Kva = total feeder kva

x = distance from substation expressed as a decimal of total feeder length.

The percent voltage drop at point x is:

$$\%D_x = \int_0^x \frac{\text{kva}\ (1\text{-}x)z L dx}{10kv^2} = \frac{\text{kva}\ zL(x - \frac{x^2}{2})}{10kv^2} \qquad (2)$$

where z = unit impedance

L = feeder length.

The percent power loss to point x is:

$$\%P_x = 3\int_0^x \left[\frac{\text{kva}\ (1\text{-}x)}{\sqrt{3}kv}\right]^2 \frac{rL\ dx}{10\text{kva PF}}$$

$$= \frac{\text{kva}\ rL(x - x^3 + \frac{x^3}{3})}{10kv^2PF} \qquad (3)$$

where r = unit resistance

PF = power factor.

When x = 1 the total loss for the uniformly-loaded feeder becomes:

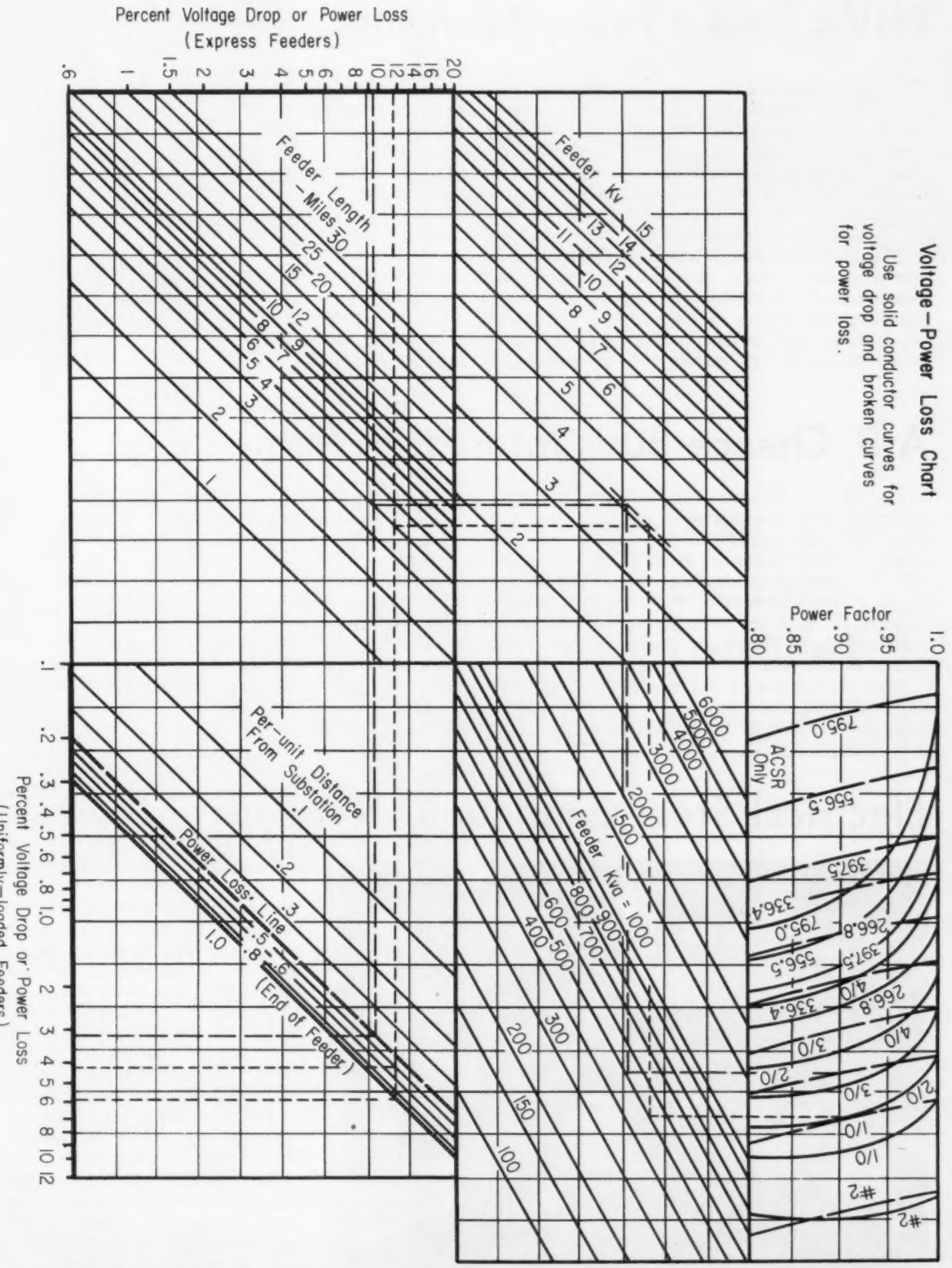
$$\%P_1 = \frac{\text{kva}\ rL}{30kv^2PF} \qquad (3')$$

Equations **(2)** and **(3')** are evaluated in the accompanying chart. For example, a 4,160-v 3-phase feeder, 4 miles long, has a uniformly-distributed load of 500 kva at 90% power factor. Conductors are 2/0 ACSR. What is the total power loss and the voltage drop at the midway point and at the end of the feeder?

Enter chart at 90% power factor and drop to the 2/0 conductor curve. (Use solid curves for voltage and broken curves for power loss.) Extend to the left to 500 kva, rise vertically to 4.16 kv, and extend to the left to feeder length = 4 miles. Then drop vertically to the power loss line to get percent power loss or to any of the per-unit distance curves to get percent voltage drop at that particular per-unit distance from the station.

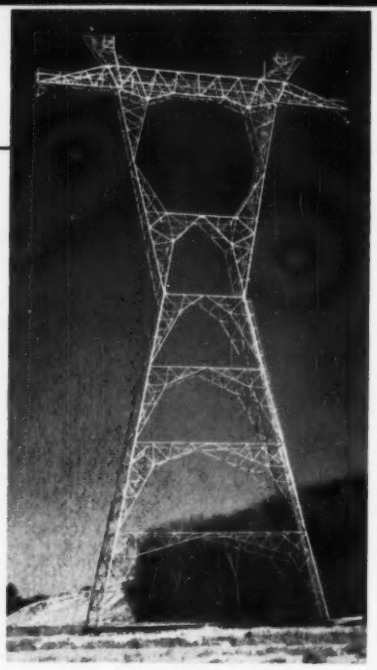
Thus, as shown by the dashed lines, the total power loss for the above problem is 3.1%; the voltage drop is 4.1% at the midway point and 5.8% at the end of the feeder.

If the foregoing had been an express feeder, the last projection would have been up, rather than down, and the loss and drop would have been 9.6% and 11.6%, respectively.


Percent Voltage Drop or Power Loss
(Express Feeders)
Feeder Length – Miles
Feeder Kv
Voltage–Power Loss Chart
Use solid conductor curves for voltage drop and broken curves for power loss.
Power Factor
Per-unit Distance From Substation
Power Loss: Line
(End of Feeder)
Feeder Kva = 1000
ACSR Only
Percent Voltage Drop or Power Loss
(Uniformly-loaded Feeders)

News of Manufacturers

EHV's Tallest Tower Fabricated



American Bridge Div of United States Steel fabricated this 166-ft, 50-ton steel tower, the highest transmission structure at General Electric Co's Project EHV near Pittsfield, Mass. It was designed by Commonwealth Associates. It will support conductors carrying up to 750 kv and incorporates three unconventional design features: narrow faces in the longitudinal direction, portal bracing below the tower waist, and shallow trusses assembled into an "H" pattern between the waist and cross-arm.

The tower supports one end of the 4.3-mile system's longest span, the 2,175-ft crossing of the Housatonic River. It is the tenth tower in the 18-tower line and the sixteenth to be erected to date—the last two towers will be erected within the next few weeks. Upon completion of the last tower, conductors will be extended from tower 3 to 18, followed by completion of the south substation and energization of the entire line.

A.B. Chance Buys Interest in Pitman

The A. B. Chance Co, of Centralia, Mo., manufacturers of utility tools and supplies, has purchased a 49% interest in Pitman Mfg Co, Grandview, Mo., according to a joint statement by N. A. Toalson, A. B. Chance Co president, and R. F. Pitman Jr, president of Pitman Mfg. Co.

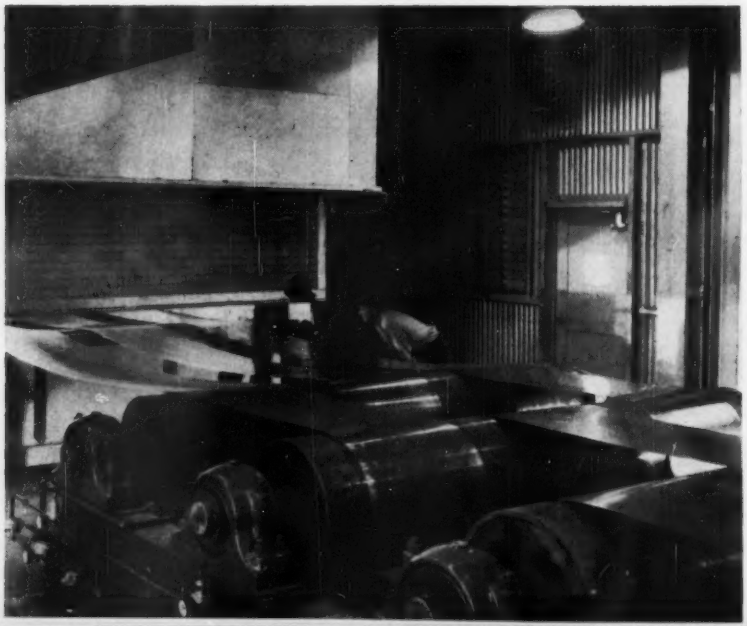
While the companies will retain their individual corporate identities, four members of A. B. Chance Co have been elected to the Pitman nine-man board of directors. Sales organizations will continue to function separately.

The affiliated companies plan to pool engineering talent and know-how, to coordinate the development of new Pitman hydraulic equipment with new and specialized tools by A. B. Chance Co.

Recent additions to the Pitman line include the compact Polecat derrick-digger unit, designed to mount anywhere in a standard line body, and the Pelican, a Fiberglas aerial bucket said to be competitive in price with hydraulic-operated aerial ladders.

A. B. Chance products include "hot-line" tools, pole line hardware, clamps and connectors, construction tools, earth anchors, grounding equipment, switch gear, insulators, and protective devices.

Electrical Steel Continuous Normalizer Started



Allegheny Ludlum Steel Corp has recently announced the initial commercial operation of its new facility at Bagdad, Pa. The plant, which has 160,000 sq ft under its roof, is a department of the company's West Leechburg Works. It is located on a 90-acre site across the Kiski River from West Leechburg Works. The Bagdad department processes high-grade, grain-oriented silicon electrical steel strip.

The new 1,040-ft continuous normalizing line, which probably is the largest normalizer in the silicon electrical steel industry, substantially increases Allegheny Ludlum's capacity for normalizing silicon electrical steel. In addition, it

(*Continued on page* 46)

INSULATORS ON THIS LINE ARE TOUGH!

Washington Water Power's 230 KV line from Lewiston, Idaho to Divide Creek

THEY HAVE TO BE . . . THEY'RE VICTOR SUSPENSIONS, OF COURSE!

When a line is erected across terrain like that between Lewiston, Idaho and Divide Creek in the rugged canyons of the Snake River, a utility doesn't gamble on service or replacement problems. That's why more and more power men look to Victor for insulators that hold up, stay up and maintain uninterrupted service.

Washington Water Power—a great name in Northwest power—is only one of an increasing number of utilities throughout the country that are finding VICTOR 10" Suspensions the answer to tough transmission problems.

Research, quality control and testing are important, but performance on the line is what really counts. Every day, VICTOR Suspensions are demonstrating their superiority in some of the country's toughest terrain and under the most adverse conditions of service.

Write Victor Insulators Division, I-T-E Circuit Breaker Company, Victor, N. Y. for full information and engineering specifications on VICTOR Suspensions.

I-T-E

I-T-E CIRCUIT BREAKER COMPANY

Installation of 60-PCL-23 C&D PlastiCal® Control Battery at new 75,000 kw Harbor Station, United Illuminating Co., Bridgeport, Conn.

United Illuminating Co. uses C & D PlastiCal® batteries for the critical job of control

By any check—capacity, convenience, economy, life—C & D PlastiCal® batteries can't be matched, when it comes to supplying instantaneous, dependable power for critical control applications.

Here at the new Harbor Station of The United Illuminating Co., Bridgeport, Conn., C & D PlastiCal control batteries have four important jobs:

1. operating control relays, pilot lights, and signals on the control board;
2. providing d-c emergency lighting;
3. closing and tripping circuit breakers;
4. emergency operation of bearing oil pumps, and main steam valves.

PlastiCal takes these important assignments in stride. Specifically engineered for control duty, this advanced-design lead-calcium plate battery has the high capacity necessary to sustain full load, when required.

PlastiCal works five times as long as conventional batteries without need for water—requires less charging current. And, PlastiCal has a life expectancy of 25 years in full-float operation.

More and more utilities are realizing the value of C & D PlastiCal batteries in control service. Ask your C & D representative for full details, or —

Send for Bulletin CP-540.

C & D BATTERIES
of Conshohocken, Pa.
DIV. THE ELECTRIC AUTOLITE CO.

Manufacturers of Sparclad® Industrial Batteries • Kathanode and Plascore® Batteries for Communications, Control and Auxiliary Power • Producers of Analyte • Silicon Chargers.
*Trademark

Electrical Steel

(*Continued from page* 44)

improves product quality and production efficiency. It also frees considerable plant space and equipment at West Leechburg Works, which was formerly used in processing silicon, but can now be made available for processing stainless steel strip.

Built by The Electric Furnace Co, Salem, Ohio, the new line will normalize silicon strip from .010-in. to .030-in. in thickness and up to 34 in. in width, at speeds up to 300 ft per min.

The high-grade silicon electrical strip produced at West Leechburg and Bagdad goes into many different kinds of electrical generating and power transformer equipment.

MANUFACTURERS BRIEFS

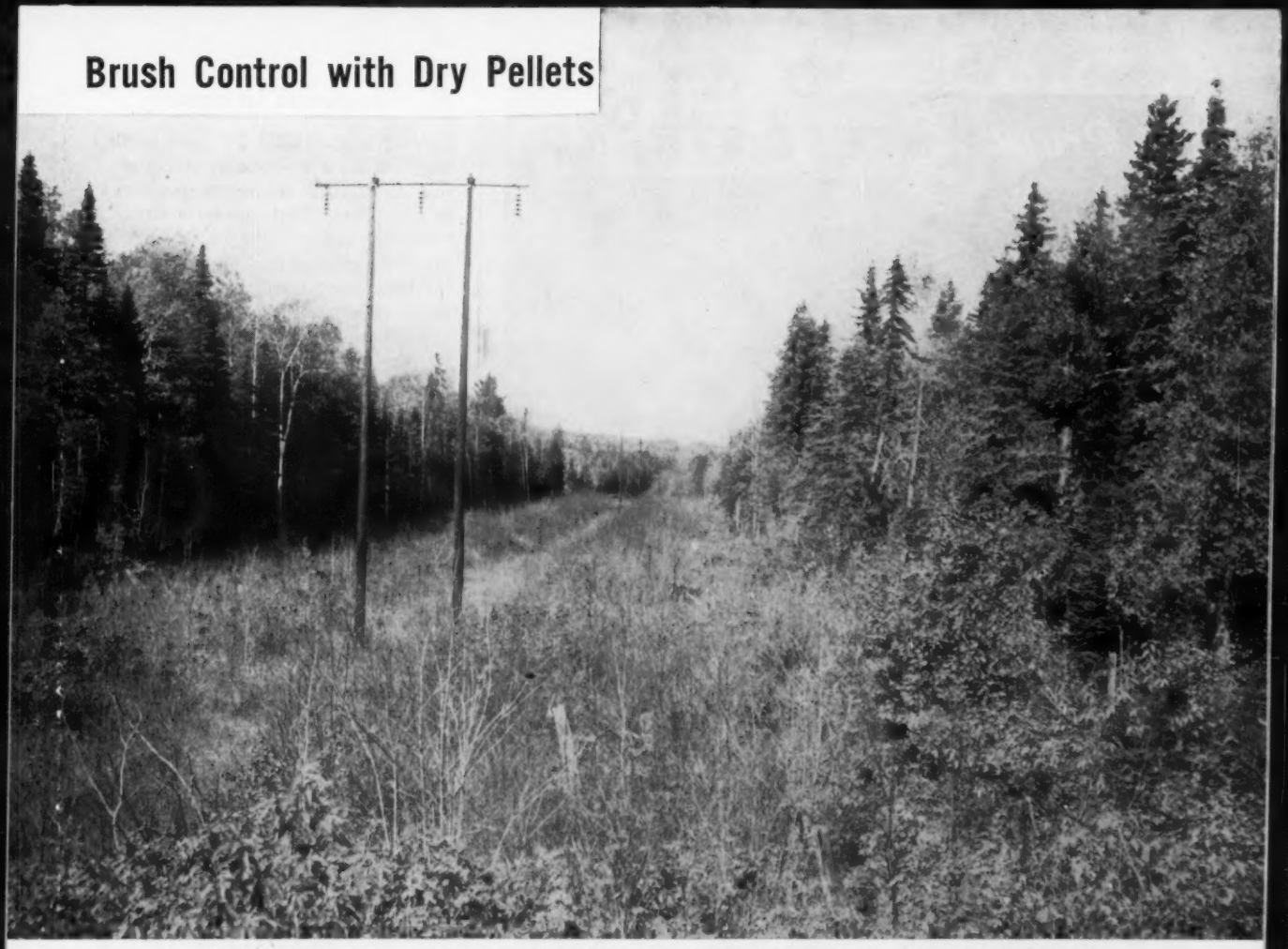
• **Federal Pacific Electric Co** is establishing a large six-plant complex to manufacture electrical switchgear in Newark, N. J. A 70,-000-sq-ft, $500,000 switchgear final assembly plant will be fed components made in five connecting plants. This centralizes the switchgear operation, including test facilities and engineering supervision, which previously was located in several plants along the Eastern seaboard.

• **Hatfield Wire & Cable Div** of Continental Copper & Steel Industries, Inc, is now offering commercially, at voltages up to 15 kv, multiconductor power cables, control cables, special industrial power cords and a wide range of other cable types. The new Linden, N. J., 300,000-sq-ft rubber insulating plant is producing the electrical equipment.

• **Delta-Star Electric Div** of H. K. Porter Co, Inc, has opened a 225,-000-sq-ft plant at Lynchburg, Va., which will make lightning arresters, current collection systems, and transformers. Two other plants: Electric Service Works at Philadelphia, Pa., and San Carlos Works, San Carlos, Calif., also will manufacture transformers.

(*More News of Manufacturers, p* 48)

Brush Control with Dry Pellets



This Maine Public Service Company right-of-way was cleared of conifers and hardwoods by pellets of Du Pont "Dybar"—scattered by six men walking abreast who carried the chemical in 10-lb. pails.

How Du Pont DYBAR® saved $13 an acre chemical cost and 50% application time for Maine Public Service Co.

FENURON WEED AND BRUSH KILLER

"We compared dry pellets of 'Dybar' with a basal stem spray application of a hormone brush killer in oil while working on brush control for the Maine Public Service Company," says Robert N. Smith* of Gould and Smith, Inc., Presque Isle, Maine. "The brush was eight to fifteen feet high; the terrain rugged.

"Six men carrying pails of 'Dybar' applied it in an area twice as wide as that covered by a spray team of four men. The team could barely keep up with the men spreading 'Dybar'. The pellet application was twice as fast as the spraying—cleaner to work with, easier to carry and odorless. We also found it easier to keep track of the amount of chemical being applied—and no mechanical equipment and cleanup were needed.

"When we applied 'Dybar', it cost $50 per acre and $63 for the other brush killer, a saving of $13 per acre. The big saving, however, came from efficiency—the pellets going on twice as fast in comparable terrain.

"Results? We found that 50 lbs. of 'Dybar' performed as well as 100 gal. of basal spray mixture—initial kill was about equal, and 'Dybar' gave better control of conifers, as well as deciduous trees. We expect a three-year killing effect resulting in fewer misses."

Use "Dybar" in your brush control program for similar results. "Dybar" kills slowly, but surely, through the roots, yet is non-flammable, non-volatile, non-corrosive and low in toxicity to humans and animals.

Where foliage spraying of brush is desired, use "Ammate" X for maximum safety near sensitive crops. You can use "Ammate" X on rights-of-way, even when they adjoin cropland planted to vapor-sensitive crops. "Ammate" X is non-volatile, long-lasting, low in cost—low in toxicity to livestock or wildlife.

For more information, write for booklet showing results of applications of Du Pont Weed and Brush Killers. E. I. du Pont de Nemours & Co. (Inc.), Industrial and Biochemicals Dept., Room 2543-N, Wilmington 98, Delaware.

**From "Application of 'Dybar' to a Right-of-Way in Northern Maine", Northeast Weed Control Conference Proceedings—1960.*

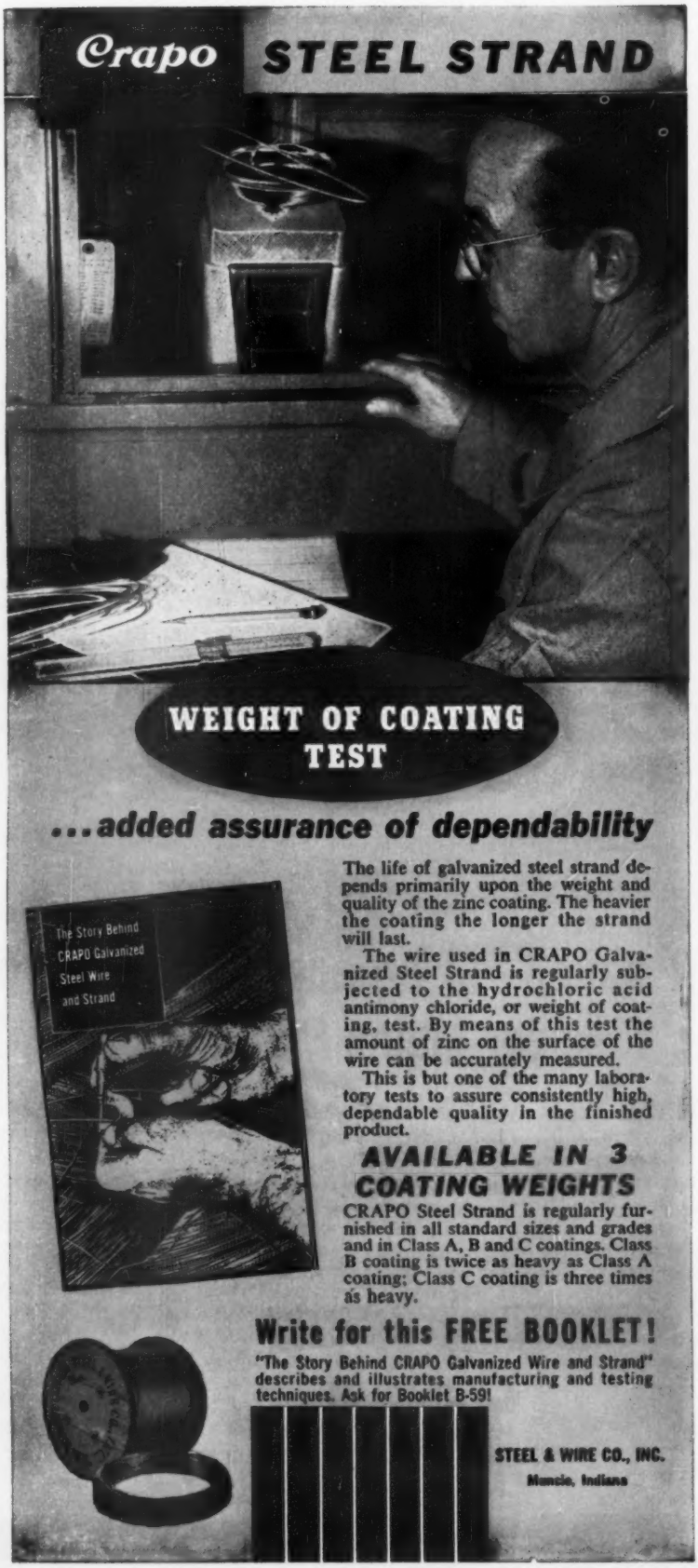
On all chemicals follow labeling instructions and warnings carefully.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

DYBAR® fenuron weed and brush killer · **AMMATE® X** weed and brush killer


Crapo
STEEL STRAND
WEIGHT OF COATING TEST
...added assurance of dependability
The Story Behind CRAPO Galvanized Steel Wire and Strand
The life of galvanized steel strand depends primarily upon the weight and quality of the zinc coating. The heavier the coating the longer the strand will last.
The wire used in CRAPO Galvanized Steel Strand is regularly subjected to the hydrochloric acid antimony chloride, or weight of coating, test. By means of this test the amount of zinc on the surface of the wire can be accurately measured.
This is but one of the many laboratory tests to assure consistently high, dependable quality in the finished product.
AVAILABLE IN 3 COATING WEIGHTS
CRAPO Steel Strand is regularly furnished in all standard sizes and grades and in Class A, B and C coatings. Class B coating is twice as heavy as Class A coating; Class C coating is three times as heavy.
Write for this FREE BOOKLET!
"The Story Behind CRAPO Galvanized Wire and Strand" describes and illustrates manufacturing and testing techniques. Ask for Booklet B-59!
STEEL & WIRE CO., INC.
Muncie, Indiana

Manufacturers Literature

H-V INSULATORS . . . are used with standard suspension construction to control conductor position in converting short crossarm structures to higher voltages. "Struts" also for control of long jumper loops, for preventing conductor swing on angle construction and for similar applications where controlled conductor position is essential. Includes description, sizes, ratings, also drawings and photographs of applications. Brochure No. 478-R, 16 pages. Lapp Insulator Co, Inc, Le Roy, N. Y.

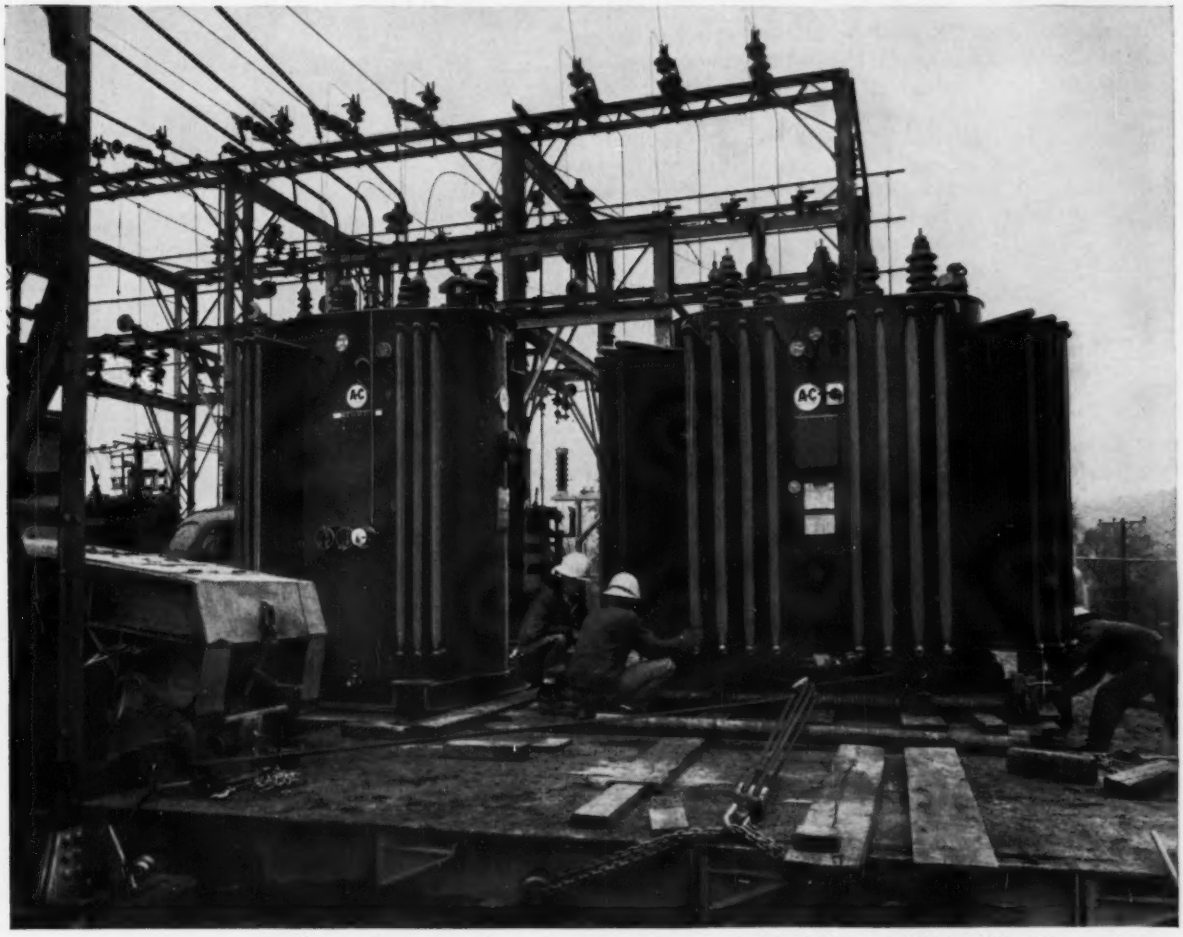
SERVICE-ENTRANCE EQUIPMENT . . . with operating and safety requirements detailed. Three basic aspects of function are covered: current-carrying efficiency (including heat rise at contacts), manual switching facility (under adverse conditions that include overloads), and speed and capacity of short-circuit interruption. Also a section on design provisions necessary for limiting and confining arcing during manual operation. Bulletin 601, six pages. Pringle Electrical Mfg Co, Inc, Dept 102, Philadelphia 22, Pa.

DIELECTRICS OF AERIAL DEVICE . . . electrical characteristics, high voltage proof tests, quality control and maintenance, electrical tests, and other factors necessary to insure electrical safety in an aerial device. Application and testing of these requirements in an Asplundh line lift. Asplundh Chipper Co, Hamilton St, Chalfont, Pa.

PUSHBUTTON STATIONS . . . for standard and heavy-duty applications. Photos of such pushbutton units and stations, diagrams showing dimensions and ordering information. Two types of buttons are available in the heavy-duty line: momentary contact and maintained contact buttons. Bulletin GEA-6544A, eight pages. General Electric Co, Schenectady 5, N. Y.

WIRE & CABLE, INSULATED . . . with silicone rubber. Single and multiconductor cable covered: power and lighting cable, hook-up wire, ignition cable. Boston Insulated Wire & Cable Co, 63 Bay St, Boston 25, Mass.

ALLIS-CHALMERS



New small power transformer increases station capacity from 2500 kva to 5000 kva with minimum alteration.

With new low-silhouette power transformer...

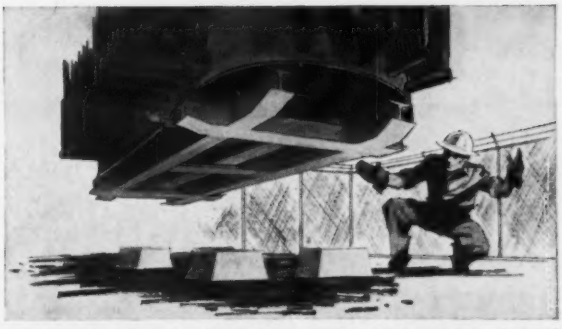
100% more capacity without raising "overhead"

West Penn Power Company installed this compact new A-C 5000-kva transformer to replace an existing 2500-kva transformer without raising the overhead structure!

You too can solve rising substation load and space problems.

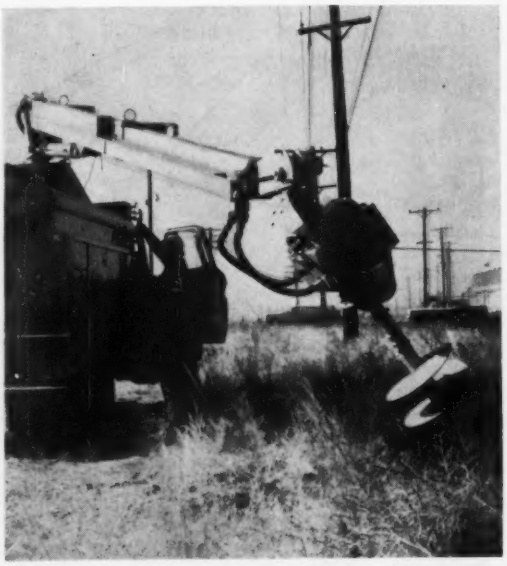
Now A-C units can replace your old transformers — deliver as much as a 30% increase in kva without any increase in unit size or weight! You never need alter your base mounting (no weight increase) or your overhead structure (no height increase).

These units, offered in 7500 kva, 69 kv and below, feature reduced losses, decreased exciting current and lower noise level. *Call your nearby A-C office for details or write* **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1438



New base design, reduced transformer weight cut foundation size and cost. No external tank bracing to catch dirt. Clean design makes painting easy.

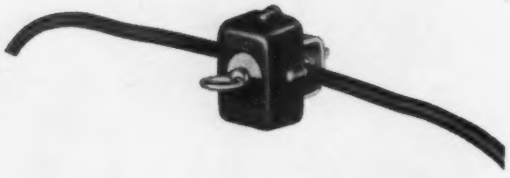
Digger Attachment . . .



. . . delivers 25% more hp at the auger and is said to save one-third to one-half the normal digging time required by previous hydraulic diggers under most normal conditions by using the high speed or spin-off gear. Two intermediate gears permit selection of proper speed for most commonly found digging conditions. A fourth or super low-gear position is supplied which develops the tremendous torque necessary for digging in shale, caliche and hardpan. Truco Denver 4-speed hydraulic digger is attached to Truco Universal turret derrick, and with 360-deg rotation of boom will dig anchor holes in any direction—rear, sides, in front of vehicle, and at any angle. A single hand lever selects choice of four digging speeds. Auger sizes are rated up to 30 in. dia.
Truck Equipment Co, 3963 Walnut St, Denver 5, Colorado

Oil Circuit Breakers . . .

. . . for outdoor use are single-tank, 5 cycle; 100, 250, and 500 Mva for 14.4 kv and below. AD-28 power circuit breakers are designed to open and/or close on 3-phase, 4 to 15-kv range to protect systems from damage under normal or abnormal circuit conditions. Units are smaller than previous designs: 8 ft 3 in. high; 3 ft 10 in. wide, and 3 ft 9 in. long. Little more than 15 sq ft of ground area is needed for installation. AD-28 is said to have only half the usual number of moving contacts and stationary contacts. The entrance bushing is a simple porcelain tube assembly mounted by means of dual conical clamping surfaces lined with cork neoprene. Breakers provide full energy for open-close-open series of operations.
Federal Pacific Electric Co, Newark 1, N. J.

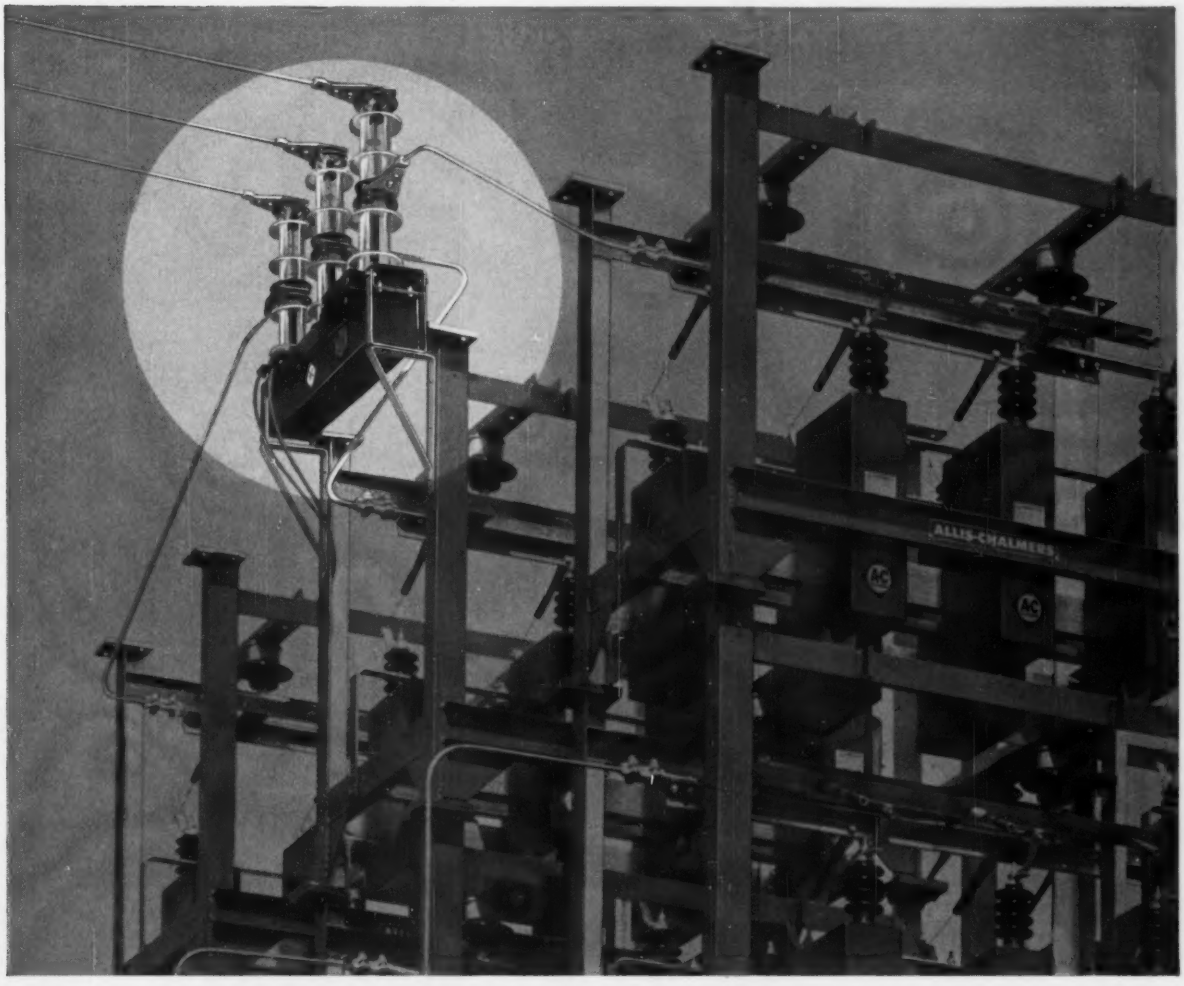


Fault Indicators . . .

. . . locate trouble without extensive shut-down. Units can be mounted on all cables from $\frac{5}{16}$ to $1\frac{3}{16}$ in. overall diameter, regardless of system voltage. Indicators are primarily for underground distribution systems served by Pad-Mount transformers or Transclosure housings and are current-operated with a tentative minimum-trip range between 300-450 amp. Exceptionally fast ½ cycle time-current characteristic enables coordination of the indicator with all over-current protective devices such as reclosers, breakers or cutouts. Indicators have weathertight housings.
Line Material Industries, McGraw-Edison Co, Milwaukee 1, Wis.

(More New Equipment on page 54)

ALLIS-CHALMERS



Now...a low-cost vacuum capacitor switch

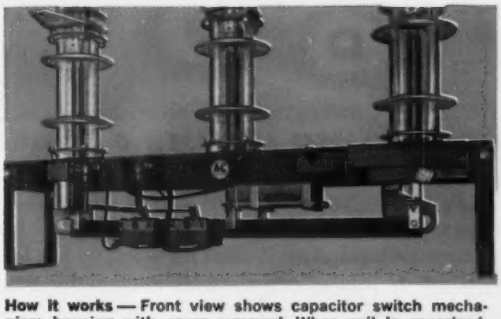
Restrike-free... lightweight... reliable

Competitive with conventional oil switches... this new 14.4-kv, 300-amp Allis-Chalmers three-phase vacuum switch is specifically engineered for capacitor duty. It operates from ac or dc, manually or by fully automatic control as the system demands. You get restrike-free performance, reliability and maintenance-free operation. Weight is one-third that of oil-type switches.

Resistance to physical damage is just as spectacular. Point-blank, 22-long rifle fire failed to penetrate the tough Plexiglas protective housing. The vacuum tubes withstood pressure tests in excess of 20 times normal closing forces.

For more information, contact your nearby A-C office. Or write **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.*

A-1409



How it works — Front view shows capacitor switch mechanism housing with cover removed. When coil is energized, solenoid plunger moves connecting rod through cam to close the contacts.

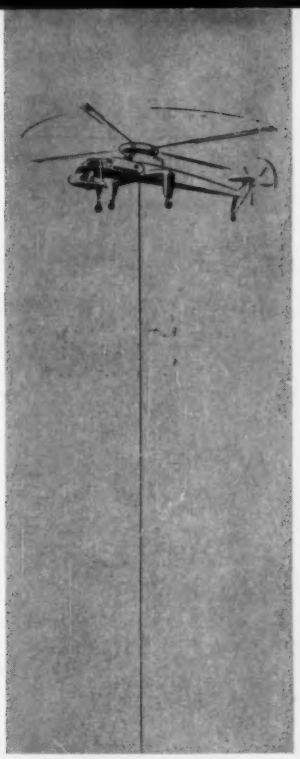
SIKORSKY SKYCRANE AGAIN DEMONSTRATES ABILITY TO OVERCOME MAJOR GROUND HURDLES

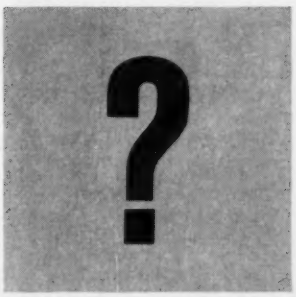
Links standardized rail, truck, and sea transportation

THIS IS A SIKORSKY SKYCRANE . . . designed to lift, carry, and set down a load suspended below. As an airborne crane, it can work at sites inaccessible to road-bound cranes—the open water, steep and rugged terrain, and dense woodland. And it does its work in far less time and with much less effort than is needed by more conventional methods.

THIS IS A STRICK-TAINER. Loaded, locked, and sealed from origin to destination, it eliminates costly multiple handling of cargo. It can be removed from a truck to a freight car and then removed again for transport to the hold of a ship. The Strick-Tainer not only reduces handling costs but nearly eliminates all loss by damage and pilferage too. It also reduces insurance premiums, and allows cargo to go through in a fraction of the time.

AND WHEN A SIKORSKY SKYCRANE MOVES A STRICK-TAINER from rail or truck to a waiting ship in the bay, or from ship to land, this cargo container becomes the most modern transfer system in the world. Transferring the container easily and quickly by the Skycrane eliminates expensive hoisting equipment—tugboat, docking, and labor fees. Loading time is reduced to a minimum, and productive sailing time increased substantially.



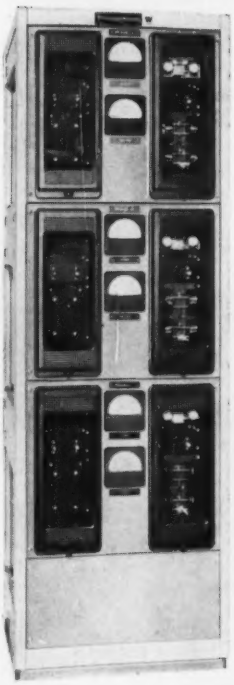


WHAT CAN THIS NEWEST SIKORSKY SKYCRANE LIFT FOR YOU? Now in production, new twin-turbine S-64's will lift and carry up to 10 tons easily as a breeze. And the load can take any shape at all: transmission towers, poles, heavy drilling or construction equipment, tools, drums, parts, vehicles, even a small bridge. The new Skycranes will also carry such detachable pods as: field offices, medical units, tool sheds, kitchens, passenger conveyances, or anything else you might need. A Sikorsky representative will be glad to give you all the details. Why not write today?

UNITED AIRCRAFT CORPORATION **SIKORSKY AIRCRAFT DIVISION**
Stratford, Connecticut

New Equipment

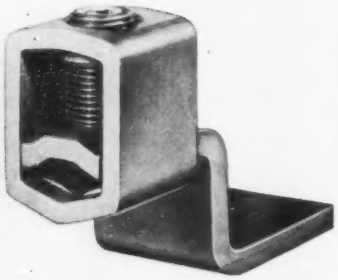
(*Continued from page* 50)



Wattmeter . . .

. . . measures transformer core losses and corona losses on high-voltage transmission lines. It is particularly suited to low power factor measurements (2 to 20%) where normal wattmeter movements cannot function accurately. The wattmeter consists of an electrodynamic torque-producing mechanism and a dc balancing element, mounted on the same shaft and using the taut-band suspension frictionless principle. When the electrodynamic element is energized, a current is caused to flow in the dc balancing element to develop torque opposing the electrodynamic element. The magnitude and direction of the balancing dc required is proportional to the power flow in the measured circuit. Taut-band suspension provides a movement with unlimited resolution—no "dead band" areas. Test cubicle pictured shows wattmeter movements for measuring losses on 3-phase transformer.

Westinghouse Electric Corp, Box 2099, Pittsburgh, Pa.



Solderless Lugs . . .

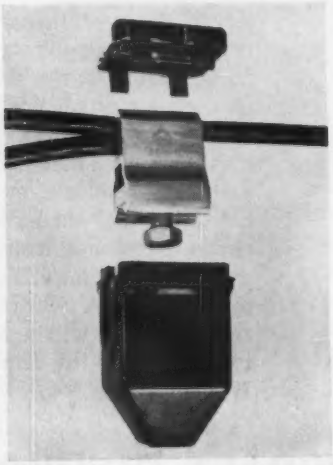
. . . are fabricated from high strength-weight ratio seamless copper tubing to produce a new line of power and electrical distribution connectors. Minimum tooling and production costs result in low connector costs. The SLUH line of dual-purpose, solderless, single-hole lugs is available from wire ranges from No. 14 to 1,000 MCM. To keep inventories at a minimum, electro-tin plated finish was specified so the lugs could be used for either aluminum or copper conductors. Although produced from high-strength seamless copper tube (and tang from heavy copper bar), these lugs are from three to four times lighter in weight than cast types of equal load-carrying capacity.

Bridgeport Brass Co, 30 Grand St, Bridgeport 2, Conn.

HV Horizontal Line Posts . . .

. . . for armless transmission construction are offered in two strength classes, each in three lengths which match or exceed flashover values for strings of 6, 7, and 8 standard 115 and 138-kv suspension insulators. Each insulator consists of two Fog-Type porcelain posts with galvanized, malleable iron hardware cemented to the ends. The many rugged petticoats provide maximum leakage distance and offer greater resistance to mechanical attack, power arc-over, and contamination. No special structures are required; the insulators are mounted directly to the side of Class 1, 2, or 3 wood poles. Economies offered are elimination of crossarms, braces and hardware, savings in materials. Most of the assembly is completed on the ground.

Lapp Insulator Co, Inc, Insulator Div, Le Roy, N. Y.

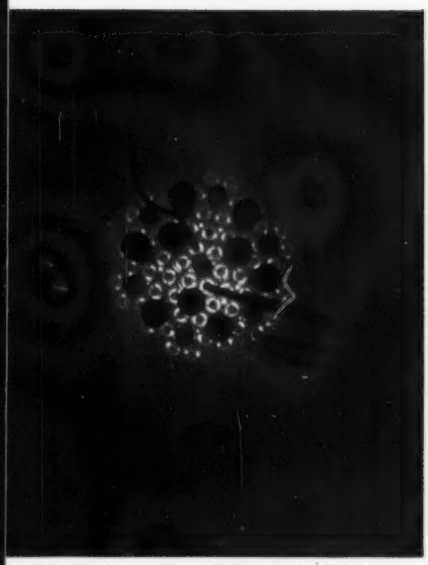


Insulating Shrouds . . .

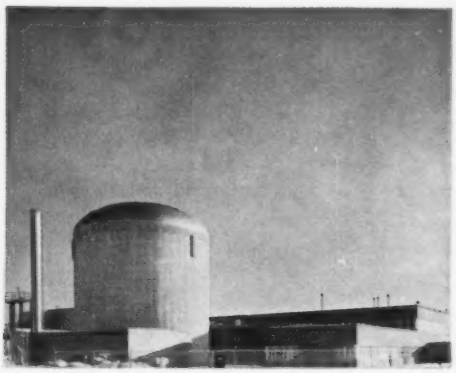
. . . are thermoplastic and used with AWCO Saddle Taps on overhead power lines. The smaller shroud, LTS-1, is made for ALT-1 tap which accommodates conductor diameters of 0.177-0.366 in. and is now available. LTS-2, for use with ALT-2 tap accommodating conductor diameters of 0.367-0.558 in., will be available shortly.

Aluminum Wire & Cable Ltd, 2 St. James's Sq, London SW 1, Eng.

60,000 kw Westinghouse testing reactor speeds radiation tests for industry and government



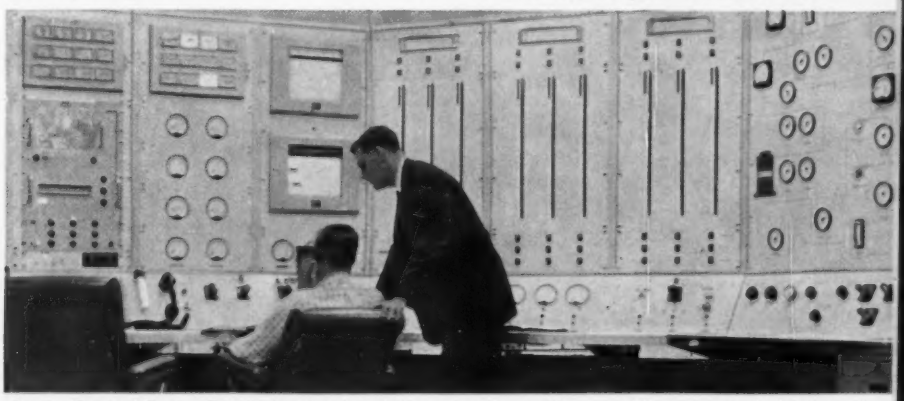
Reactor Core. Nuclear fuels and other materials can be tested inside cylindrical fuel elements.



Testing Reactor Facility. Most powerful privately-owned complete facility in U.S. Available to serve industry and government.

Critical Experiment Station. Low power test facility used to confirm physics of experiments before exposure in the reactor.

Remote Handling Facility. Hot cells and metallographic cells are available for post-irradiation examination of samples.



Master Control Room. This is focal point of the operating facility; providing remote indication of reactor performance and experimental conditions.

Complete Laboratory Facilities. Chemical, analytical and counting laboratories are used to make post-irradiation tests.

Test Loop Control Center. Loops are available to provide a variety of environmental conditions during irradiation.

JI-59502

Westinghouse

Westinghouse Testing Reactor
Box 868, Pittsburgh 22, Pa.

Electricity, Gas Battle for Attention at Show

From the ribbon-cutting moment on, the annual Philadelphia Home Show was highlighted by the theme electric vs gas.

To open the show, Dr I. M. Levitt, physicist from the Franklin Institute, had cooked up a gadget, an "electronic stethoscope," which would pick up Philadelphia Mayor Richardson Dilworth's heartbeat, amplify it, and set off a magnesium "bomb" to cut the ribbon.

When the gadget was placed where it would pick up the heartbeat, nothing happened. Electrical men feared modern electronics would have to be replaced by old-fashioned scissors.

Then someone recalled that the local gas company had previously asked permission temporarily to disconnect an electric circuit. It was the same one which was supposed to supply power to the "stethoscope". Once the circuit was hooked up, the ribbon was cut and the show got underway.

Both the Electrical Assn of Philadelphia and Combined Gas Industries were exhibitors.

Electrical World's correspondent queried visitors to find if they would choose gas or electric appliances. A poll of 30 people showed gas edging electricity. Potential customers picked electric ovens and electric refrigerators as "best" possibilities, but preferred gas water heaters and gas ranges in those categories.

Oil got top pick for fuel, 29-1. All were satisfied with the fuel now used to heat their homes. Some thought gas a good possibility but none thought of electricity as a main source but as an auxiliary.

Philadelphia Electric Co, in cooperation with the Electrical Assn of Philadelphia, featured a Gold Medallion Home. Visitors thought the home nice but doubted if they could afford it.

Builders seemed divided on whether gas or electric was easier to sell. They felt that an all-electric home has more dramatic appeal, but that an all-around house is easier to market.

Philadelphia Electric Co punched away at all-electric kitchens for redeveloped urban properties.

The electric utility and the Philadelphia Gas Works were co-recipients of the "Most Attractive Display" award, intensifying the neck-and-neck situation throughout the run of the show.

Heating Consumption Recorded on Separate Meter

A new low rate put into effect this winter by Central Power & Light Co permits residential customers with both electric water heaters and permanent 230-v electric heating equipment to heat their homes for about 1¢ per kwhr, just about half of what it cost last winter.

Consumption under the new heating rate is recorded on a separate kwhr meter energized through a special winter-summer switch (see photo). Now, 474 CP&L customers have taken advantage of the rate.

The winter-summer switches are supplied by the company to any residential customer who qualifies. The switch permits all energy for electric heating to be recorded on the water heater meter during the five winter months and billed at the new low rate.

The switches were changed to the winter position during the October-November meter reading cycle. CP&L reports that additional requests for the switches grew with the approach of colder weather. Customers building new homes, or adding water heaters or permanent 230-v heating equipment, are advised to have this load installed on separate circuits for connection to the winter-summer switch.

The utility estimates that under the new rate the cost of operating a central unit heat pump during the winter will average less than $1.80 per month per ton of capacity. A three-ton heat pump in a properly insulated house of 1,200-1,500 sq ft can be operated for $5-6 per month.

Electrical World

MARCH 6, 1961

Management Newsletter

What Price for New Utility Money?

How much will the electric utility industry have to pay for its money in 1961? Compared to other years, 1961 ranks as one of the tougher years to predict. For one thing, a new administration, representing a different party and different economic leanings, is just taking office. And despite campaign promises and predictions, there is as yet only fragmentary evidence of what its money policies will be. In fact, there is some evidence that the new Administration may not have made up its own mind as yet, beyond a few broad objectives. And there are plenty of complications—topped by such posers as the current business recession and the prospects for the cold war—for the new government economists.

Moreover, there are contradictory elements in some of Kennedy's announced plans. On one hand, Kennedy and the Democrats have committed themselves to easing of credit and cheaper money, avowedly to spur the present recession. Similarly, longer and lower mortgages, to pump some steam into residential housing, are another of Kennedy's announced aims. But so is increased defense spending, which should increase demand for and thus cost of money. Moreover, despite some small, early gains, the Administration still has a stiff problem in cutting back the gold exodus.

One potent method of cheapening credit is by modifying Federal Reserve Board policy, either through lower rediscount rates or by reducing the reserves which member boards are required to carry. Semi-political in nature, the Federal Reserve Board has often been influenced—but seldom controlled—by political pressure in

the past. The recent FRB action is buying long-term government securities may exemplify such a response to Administration desires. But it's hard to tell just how far the Board might go in carrying out the new Administration's mandates if the Board, and particularly the Chairman, had reservations about the desirability of the mandates. And since none of the 14-year FRB terms expire in the next year, Kennedy will have little chance to influence FRB policy through new appointments.

Even more critical than FRB reluctance is the now familiar "gold flow" problem, which the President is pledged to alleviate. One weapon for restraining the gold exodus is to maintain a reasonably high yield on Treasury bills of 30, 60, and 90-day maturity, especially the last. Right now, the rate for 90-day bills is about 2.6%. If it drifts much lower, some overseas flow of gold seems sure to follow, as investors in short-term paper turn to the higher yields offered in Europe.

While gold flow is affected chiefly by short-term paper, the yields on 90-day Treasury bills do tend to carry over and affect yields on long-term US government securities. And yields on the latter inevitably influence yields on utility funded debt—and thus the cost of funded debt to utilities. Right now, Kennedy's aim appears to be to increase short-term credit rates, where gold flow is most affected, but push down long-term money. The policy has already had some success, yields on 90-day Treasury bills have risen about 0.30% per annum, while long-term bonds have fallen about 0.25%. But the long-range outcome is still in doubt.

Another imponderable is the "overhang" of possible government long-range securities. For some years past, the outgoing administration had been dedicated to a general policy of "stretching out" the federal debt—raising the average maturity by issuing securities of longer maturities—which may reasonably be considered competitive with utility funded debt issues. Actually, the past administration accomplished little in this area. But whenever a move was made in this direction, the result was a prompt stiffening of funded debt yields. With an announced aim of lowering, long-term credit costs, the new Administration will probably not attempt much "stretching out" in the near future. But until an express statement removes this threat of "overhang" from the realm of possibility, it will remain a mildly adverse deterrent to lower interest yields.

But what about that old economic giant, supply and demand? What effect will it have on the price of money for utilities? All in all, probably not too much in the present year. Comparing the amount of securities sold by the industry in 1960 with the best estimates of their 1961 needs shows something like this:

	Millions of Dollars	
	1960	**1961 (est)**
Bonds and Debentures	$1,442	$1,500
Preferred Stock	201	200
Common Stock	108	200
Total	1,751	1,900

Based on these estimates, funded debt would increase $58 million or about 4% over that raised in 1960. And the change in the amount of preferred stock would be little or nothing. So demand for senior utility securities doesn't seem likely to be much of an influence on bond yields and other senior money costs.

But other funded debt securities can be a factor in money costs, too. For example, funded debt of industrial and commercial corporations; government securities maturing in ten years or more; and mortgages on housing and other building construction. Most estimates predict a downturn in the supply of industrial securities in 1961, as a result of a slower expansion in industry in general. The amount of financing for housing construction will probably depend on US government policy on money rates. In fact, small decrease in some mortgage rates have been advocated by the President. Best guess on this score would be for some increase in the amount of mortgages financed in 1961 over those in 1960.

As for long-term government securities, at present there seems little risk of substantial competition from this source.

Looking at both sides of the picture, here's how the influences on cost of funded debt line up. Tending to push costs of money down are:

- The new Administration's general policy on credit
- Lower money demands due to the recession
- The possibility of lower rediscount rates of a more liberal reserve requirements by the FRB as a business stimulant
- Reduction in the overhang factor of federal long-term offerings.

Working against these factors and tending to push money costs up are:

- The need to uphold short term rates to prevent a bigger gold exodus
- Increased federal spending and the possible inflationary effect it would produce.

What is the "net-net" of all these plus and minus factors? Allowing for the imponderables of a new administration, probably a lowering of utility bond yields for the year. In terms of a triple "A" rated electric utility bond, the decline might be from 0.40 to 0.45, dropping yield from its present 4.55% to around 4.15 to 4.10. Of course, this doesn't mean that yields at the end of 1961 will be this low. There is a clear possibility that money rates will fall in the early part of 1961, then rise later in the year if business activity speeds up.

Comparing average during-the-year yields on triple "A" rated utility bonds for 1960 and 1961 seems to indicate a per annum drop of about 0.40%. Bonds such as these brought to market at the beginning of 1960 yielded about 5.0%. At the end of the year, yields had dropped to between 4.5 and 4.55%. Allowing the ups and downs during the year, an average of 4.75% would seem reasonable. Compared with this, an average of 4.55% at the beginning of 1961 and the 4.15% estimated low for the year would produce an annual average of 4.35 for 1961—about 0.40% below that of 1960. On this base, the decline represents more than 8% in the cost of funded money for utilities.

Does this mean utilities should change financing plans, either by speeding up or by delaying issuance of securities in the early part of 1961? Not necessarily. The soundest course seems to be in raising money concurrently with need for these funds. Of course, the cost of money early in the year could prove to be somewhat lower than it is later in 1961. But neither the indicated differential nor the assumptions on which it is based seems substantial enough to justify departure from normal schedules for funded debt offerings.

Then what about the outlook for common stock equity funds in the coming year? Tending to drive the price of stocks upward are:

- The Administration's promise of cheaper money rates
- The prospect of increased federal spending
- An increase in inflation psychology as a result of this federal spending
- Expectations of an end to the recession by mid-1961, or earlier.

Working against these influences and tending to hold down stock prices are:

- The possibility of lower defense spending if the cold war lets up
- The possibility that the recession may exceed present expectations
- The high price-earnings ratios of many stocks.

As for supply and demand, the $200 million of utility common stock estimated to be offered this year is about twice that offered in 1960. But if business expansion falls somewhat behind that of last year, as now expected, the amount of common stock issued by industrial and commercial corporations should fall off. And, in any case, the $100-million increase for electric utilities does not seem large enough to affect market prices or the cost of equity money to a material degree.

On the whole, the factors working for higher prices seem to outweigh those holding prices down. But no runaway market appears in sight. In fact, the substantial

increase in market prices so far this year may include all or most of the ultimate net upturn for the year. The market customarily discounts anticipated good news and seems to have done it in this case. So if the good news does not live up to expectations, a decline is possible. What seems most probable is not a gradual increase throughout the year, but a moderate rise in the early part of 1961 with a levelling off or even a slight decline when the favorable turn in business activity actually takes place. Certainly, a continued rise at the rate to date seems unlikely. In any event, average prices at year end will probably top those of last December.

Where do utility stocks fit into this pattern? In 1960, when the market was declining something like 10%, according to most of the important stock averages, the average for electric utilities and utilities generally was rising considerably. Investors, worried by the market's uncertainty and the expected recession, were turning to utility issues as defensive stocks. But circumstances are different this year. The emphasis is on the recession's end and on more federal spending, with inflationary overtones. Both factors, and especially the latter, favor the more speculative stocks. So while utility stocks should gain some this year, it will probably be less than industrial and over-all averages.

Price-earnings ratios are working for the utilities, too. Thus, in 1960, the average price earnings ratio—which in effect determines the cost of common stock money—fluctuated between 16.7 times in January and 16.9 times in December. Monthly average was about 16.83, just about the equivalent of a 6% cost of common stock money before deducting selling expense. But by the beginning of February, the utility price-earning ratio had already climbed to 18.5%—more than 12% above the December, 1960 level. And there are prospects that the PER for utility stocks in 1961 will go to 19, an equity money cost of 5.27% before expenses.

What does all this mean to utilities? If this assumed saving in the cost of common stock money, about 0.75% per annum, is applied to the $200 million of common stock to be sold in 1961, it mounts up to some $1.5 million annually. For an assumed period of 30 years, the aggregate would hit $45 million in gross after-tax savings. So with money cost before selling expenses hovering at about 5.4% utility common stock offerings seem to have a bright green light for raising the equity money needed for the next two years. Of course, the cost of money may drop a little more, later in 1961. But even present costs warrants fast marketing action.

And this is not all the potential savings for utilities. Applying the estimated 0.40% estimated annual saving per annum to the 1.5 billion of estimated funded debt to be marketed in 1961 would produce an annual saving of $6.0 million. Multiplied by 26 years, the customary life of a utility funded debt after allowance for a 1% annual sinking fund, these annual savings would provide a total of about $156 million. So total savings, including the estimated $45-million possible saving in common stock money, and the savings in funded debt costs, would hit about $200 million, plus a small saving on the estimated $200 million in preferred stock.

But what if the cost of plant facilities the utilities will buy in 1961 is boosted by increased federal spending, the end of the recession, and greater international tensions, or some combination thereof? Would this extra cost outweigh the estimated savings in money costs on financing in that year? Probably not. Estimated construction expenditures by investor-owned utilities in 1961 total about $3,519 million. If the over-all life saving on the new securities is taken at the approximate $200 million estimated above, the industry could absorb a rise of over 5.5% in the estimated cost of the facilities purchased in 1961 and still come out even.

Of course, some of the $3.5 billion for 1961 construction was committed prior to that year at prices then prevailing. But this figure is not too far out of line as indicating the amount to which 1961 prices will be applicable. And if price increases do not materialize or are less than 5.5%, the gain in lower money costs in 1961 security offerings would be a net advantage to the utility industry.

Wisconsin PS Names Three To Be VPs

FABER ROEMER ELLIS

Three new vice presidents have been named at Wisconsin Public Service Corp: D. W. Faber, secretary; L. G. Roemer, treasurer and director; and P. G. Ellis, assistant to the president.

Faber's and Roemer's appointments keep them in Milwaukee, where they have been serving. Ellis' promotion involves a change of residence, from Milwaukee to Oshkosh where he will have headquarters as vice president-division operations. In this capacity, he succeeds H. I. Miller who retired.

Faber has been with PS since 1922. He held numerous auditor posts before becoming assistant secretary and assistant treasurer in 1928. Since 1938, Faber has been the corporation's secretary.

Roemer, who joined PS in 1926, was an accountant in several of the corporation's divisions until 1947, when he was named assistant secretary and assistant treasurer in the Milwaukee office. He became a director and treasurer in 1955.

Starting as PS' property records accountant in Green Bay in 1936, Ellis subsequently was Milwaukee office budget director, supervisor of rate and research department functions, assistant to the president, and, since 1954, assistant vice president.

Armstrong Named VP at El Paso Electric

El Paso Electric Co has elected John F. Armstrong vice president. Armstrong became Mesilla Valley division manager, succeeding Vice President John A. Davis Jr who was promoted to higher responsibilities in El Paso main offices.

Armstrong joined El Paso Electric in 1933. He was subsequently meter test engineer, industrial sales engineer, distribution engineer, assistant to general superintendent, transmission engineer, special assignments engineer, and, for the past eight years, general engineer.

JOHN F. ARMSTRONG ▶

Slade Is Iowa P&L Senior Vice President

Iowa Power & Light Co has named L. E. Slade senior vice president. He will direct operations including customer relations and service, and production, transmission, and distribution.

Slade was formerly financial vice president, secretary, and treasurer.

Others elected were: R. L. Meyer as treasurer; Guy G. Gilchrist as secretary; and Ralph F. Mowen and Herman Zieg as assistant treasurers.

◀ L. E. SLADE

(*More News About People on page* 64)

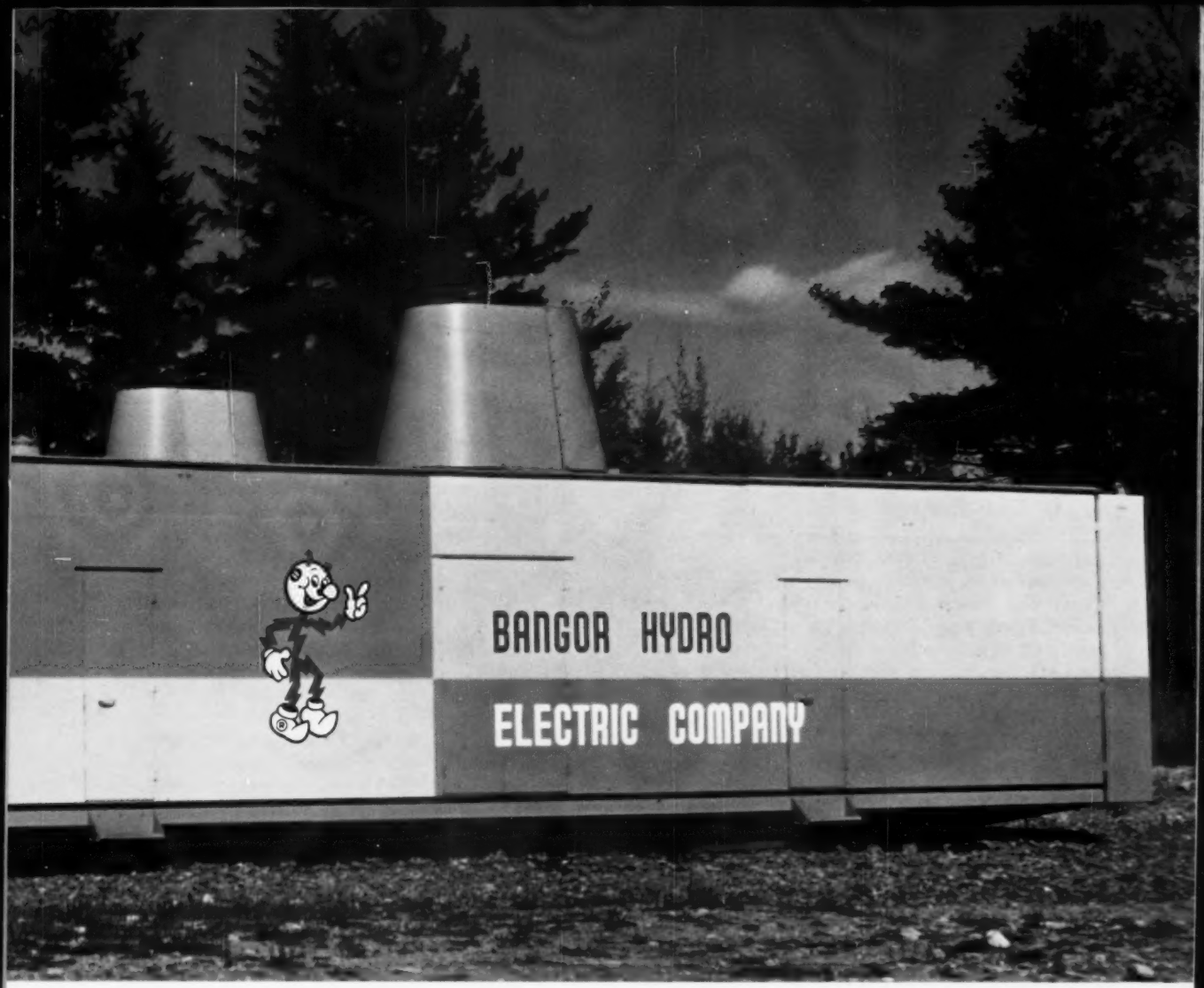
Bangor Hydro-Electric Co. *again* picks Electro-

In the summer of 1958, Bangor Hydro-Electric Company completed an economic analysis of future generation requirements on its system serving four counties in eastern Maine. With load growth averaging approximately 8,000 KW per year, Bangor Hydro-Electric studied three alternate methods to provide increased capacity for a six year period beginning in 1960:

1. Addition of preferred standard steam plants of 22 MW in 1961 and of 33 MW in 1965 or 1966.
2. Addition of a peak-shaving steam plant in 1961 and a preferred standard steam plant in 1963.
3. Addition of Diesel "end-of-the-line" peaking units in 1960, with similar installations in 1961 and 1962, combined with a preferred standard steam unit in 1964 or 1965.

Conclusions drawn from this study showed large savings could be realized with peak-shaving equipment. The Diesel Plan #3 showed the greatest savings by a considerable margin, varying from $100,000 to $790,000 per year.

ELECTRO-MOTIVE DIESEL PLANT—The initial Diesel peaking unit has been installed at Medway, Me., to provide "end-of-the-line" area protection and peaking service. The 8,000 KW Plant is remotely controlled from the hydro station. To provide area protection, the Plant starts, synchronizes and goes on line, in less than two minutes. Bangor Hydro-Electric picked the Electro-Motive Peaking Plant to produce adequate capacity for its system at lowest possible costs, while improving service reliability in remote areas.



Motive Peaking Power for maximum savings

SECOND ELECTRO-MOTIVE DIESEL PLANT—*The success of the first Electro-Motive Plant at Medway led to the order of a second 8,000 KW plant to be installed in the southern area of the system. Due to be operating by the Fall of 1961, the new plant will also provide additional peaking capacity along with protection for another "end-of-the-line" area.*

FLEXIBLE AND RELIABLE—The inherent design characteristics of the Electro-Motive Equipment at Bangor Hydro-Electric that make it ideal for peaking and area protection, also make these Plants ideal for many of your system requirements. With Electro-Motive Equipment, you get fast start for spinning reserve, automatic dead load pick-up for area protection, remote control for peaking service, portability for simple installation, and freedom from damage to components caused by rapid thermal changes occurring from start to full load.

Electro-Motive Peaking Plants, available in sizes ranging from 2,000 KW to 10,000 KW, permit the most economical and efficient peaking operation, and provide for expansion at the lowest possible cost. Ask your Electro-Motive representative for complete details. 61-U-9

ELECTRO-MOTIVE DIVISION · GENERAL MOTORS

LA GRANGE, ILLINOIS

In Canada: General Motors Diesel Limited, London, Ontario

PERSONAL BRIEFS

Iowa Public Service Co has made the following appointments: **George Trainer** as general superintendent of gas distribution for the Sioux City division; **Bob Danielson** as superintendent of overhead distribution and **Glenn Berryman** as assistant superintendent, for the Sioux City division; **Maynard Bennett** as general superintendent of electric distribution for the division; and **Don Eck** as manager for Shell Rock and Waverly districts.

Three veteran employees of Kansas City Power & Light Co have retired: **Don V. Lynn,** head of the real estate department; **Daniel R. Scott,** a system dispatcher; and **Edwin P. Foley,** a member of the meter department. Kansas City Power & Light Co has named **Frank Lacy** real estate department superintendent, succeeding Lynn (see above), and **William L. McCool** became assistant superintendent.

At Mississippi Power Co, **H. H. Bell** has been made assistant operating manager; **H. R. Brown,** assistant division manager of the Hattiesburg division; **Waldo C. Bounds,** Laurel division superintendent; **J. E. Kizzire,** assistant division manager of the Gulf Coast division; **Ladell Beckham,** supervisor of land and construction in the Gulfport office.

Mississippi Power & Light Co has appointed **Alex McKeigney** director of community relations and **Donald J. Gray,** executive assistant to the president.

H. O. Sprinkle has retired as executive vice president of Monongahela Power Co.

The newly created post of director of legal services at Potomac Edison System has been filled by **Frank L. Morgal.**

Virginia Electric & Power Co has named **Andrew C. Brown Jr** assistant district superintendent of the distribution department; **B. Albert Burton III,** assistant to the Richmond district manager; **William L. Woodfin,** Richmond service superintendent; **Raleigh T. Harrington,** building maintenance assistant in the system transmission and distribution department; and **David L. Betts,** a coal handling foreman.

Appalachian Power Co has appointed **Dorman M. Miller** and **Julian C. Hansbarger** executive assistants.

Robert R. Hern has been named manager of the Hillsboro, Ohio, division of Columbus & Southern Ohio Electric Co, succeeding **A. R. Helrich** who retired.

Pacific Power & Light Co has made **Rex W. Beeman** administrative assistant to the general manager and **William G. Walker,** assistant to the Oregon division manager.

Iowa Electric Light & Power Co has appointed **Peter Stover** as director of purchasing and stores and **Don Hunt** as chief mechanical engineer. Stover replaced **Marvin Wright** who retired.

Thomas P. Jones, Westinghouse Electric Corp vice president, has been elected president of the Electrical Assn of Philadelphia. Others elected were: **Sylvan Drucker,** Independent Wiring Co president, as vice president; **William E. Rubert,** Union Electric Contracting Co president, as secretary; **Emery W. Loomis,** past president of the association, as treasurer; and **Biron G. Ganser,** Philadelphia Electric Co systems division manager, as assistant treasurer.

Lucius H. Bassett will become plant manager at Anaconda American Brass Co's Los Angeles division, succeeding **Warren J. Robinson** who retires April 1. **Fritz L. Meeske** has retired as vice president of the Anaconda Wire & Cable Co, but will continue as a director.

At Allis-Chalmers Manufacturing Co, **Walter L. Peterson** has become assistant manager of the motor and generator department; **Robert E. Horn,** acting manager of the regulator department; **John L. Ficken,** assistant engineer, thermal power department; and **Frederick J. Ross,** engineer-assistant, nuclear power department. **Edward D. Kendrick Jr** and **Thomas V. Wambach** were assigned to the nuclear power department; **Richard P. James** and **Sheffey N. Massey Jr** to the power equipment division; and **Douglas A. Koch** and **William A. Kumpf** to the pump and compressor department. In the industries group, **David Eng** has been named to the engineering analysis section; **Arnold La Farge Jr** became application engineer, Norwood (Ohio) pump department; and **Edwin G. Schmitt** was named assistant engineer, motor control center.

Robert G. Faverty, vice president in charge of British operations of Thor Power Tool Co, has been appointed vice president and general manager of the company.

Douglass S. List has become midwest division manager for Hubbard & Co, with headquarters at 200 S Michigan Ave, Chicago.

E. Gonzalez-Correa has assumed the newly created post of manager microwave department, in Philco Corp's Lansdale division.

Lewis S. Armstrong has been named northeastern region manager of the A. B. Chance Co, succeeding **E. J. Higgins** who resigned.

Guy R. Porter Jr has been appointed Atlantic regional manager for Gould-National Batteries, Inc.

OBITUARIES

Warner S. McCall, founder and former president, Central Power & Light Co . . . **Earl P. Huber,** assistant secretary, Southern Indiana Gas & Electric Co . . . **Roy E. Uptegraff Sr,** 73, board chairman, R. E. Uptegraff Manufacturing Co . . . **George L. Schug,** 62, service supervisor, Public Service Electric & Gas Co . . . **John Smallshaw,** 64, credit and general services manager, Canadian Fairbanks-Morse Co, Ltd . . . **Samuel A. Ferguson,** 44, vice president and general manager, Sylvania Electric Products Co . . . **Albert T. Jewell,** 82, retired land and right-of-way agent for Arkansas Power & Light Co.

(*Continued from page* 38)

in water, but potential was not applied. Several materials not common to more than one test showed up well in the tests made on them, but butyl, which came near the top in all three, was the only one to do so in any two of the reports.

X-ray inspection of cable splices and potheads improves the performance of splicers, who are conscientious but decline to admit that some of their work might be defective until they see it on film, reported T. L. Bourbonnais II, E. I. du Pont de Nemours & Co. Non-destructive inspection with portable x-ray equipment showed voids in 95% of terminations. A leading cause was taking out pouring spouts too soon after pouring hot compound, which continued to shrink as it cooled and left voids. Other defects were due to metal parts and connectors not properly aligned or seated.

Discussion by C. W. Callow of Southern California Edison Co corroborated these findings and added as a further cause improper venting while pouring compound. He urged the development of lower-viscosity compounds with less shrinkage, preferably usable without heating.

Lightning Surges Affect Circuit Breaker Values

Lightning surge voltages in substations caused by line flashover was the subject of a paper offered to the switchgear sessions. It was written by C. F. Wagner and A. R. Hileman of Westinghouse and was presented to the meeting by Hileman.

The paper proposed circuit breaker impulse tests based on calculations of lightning surge voltages which enter substations after origination by line flashovers and also on the basis of laboratory tests of rod and ring gaps.

Hileman noted that the current effect of such a stroke results in the propagation of a voltage to ground on the conductor. This voltage, he said, rises to a high value in zero time, and the sloping of its front is proportional to the

(*Continued on page* 69)

Research
Responsibility
Results
WHEREVER GASES ARE
CLEANED OR HANDLED...
Aerotec Industries offers more than a half century of world wide experience in engineering and manufacturing equipment for efficient and economical cleaning and handling of air and gas. Single responsibility for complete systems, from design to final installation, assures management that overall performance guarantees will be met. Write for information on the products of interest.
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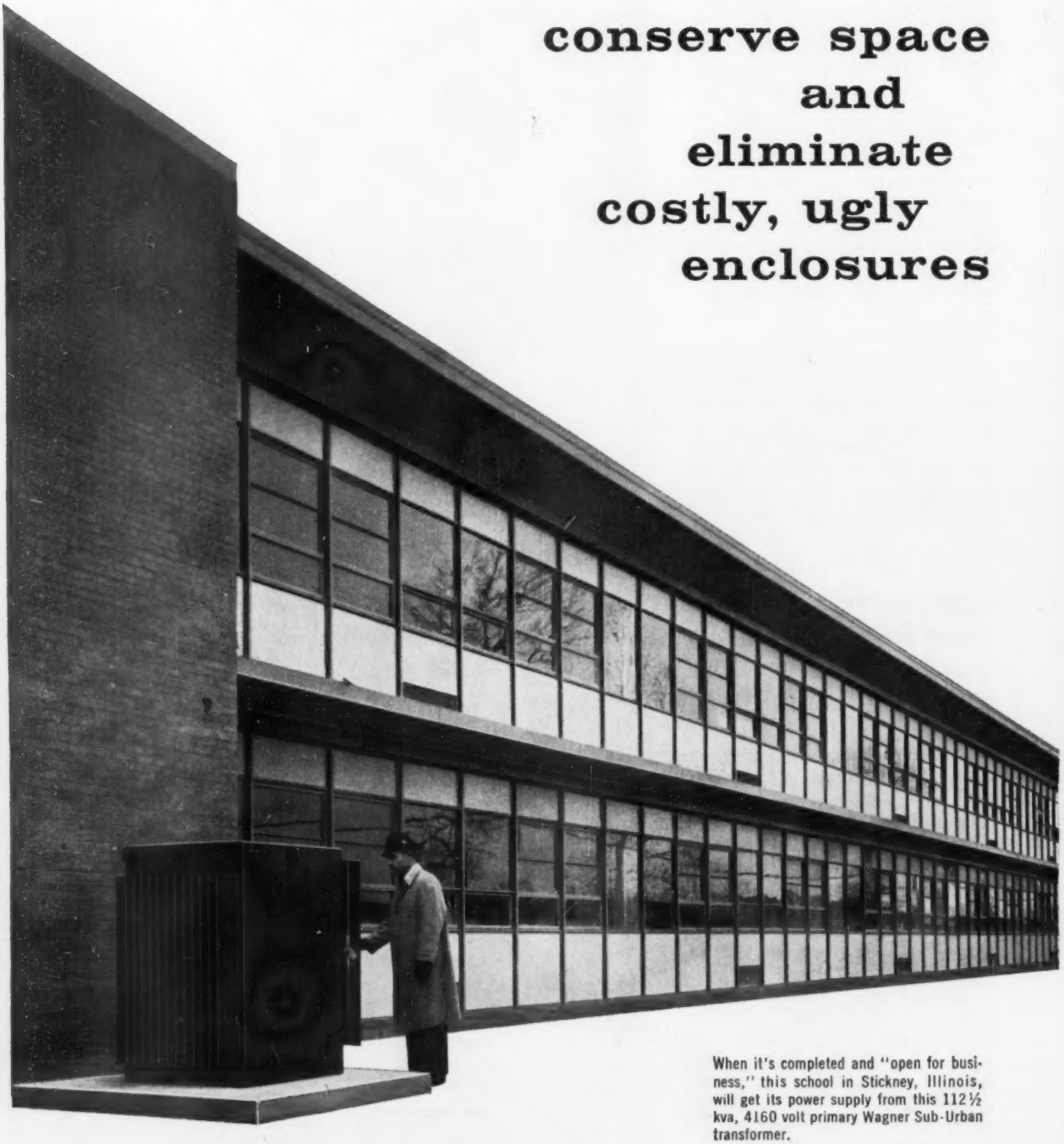
In Industrial and Commercial Installations . . .

WAGNER® SUB URBAN PAD

conserve space and eliminate costly, ugly enclosures



When it's completed and "open for business," this school in Stickney, Illinois, will get its power supply from this 112½ kva, 4160 volt primary Wagner Sub-Urban transformer.

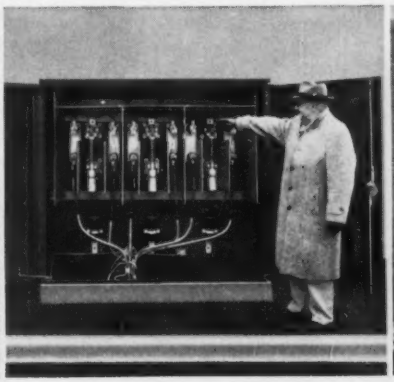
MOUNTED TRANSFORMERS

Thinking of going undergound? If you're planning a new distribution substation... reworking or modernizing an existing system... write Wagner® Sub-Urban pad mounted transformers into your specifications. It's the economical way... the complete unit is mounted above ground, and no costly vaults or enclosures are necessary. Save space, too. They're so well ventilated they can be installed close to the building and still be loaded to capacity. Some low shrubbery will hide them neatly... the good looks of your buildings and landscaping are retained.

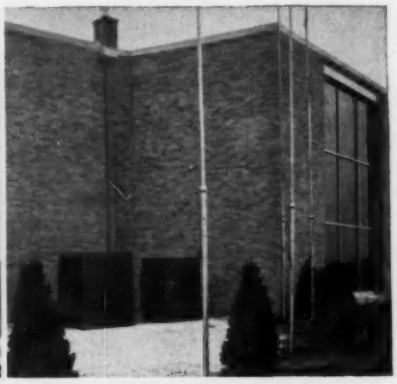
Incoming lines and outgoing feeders are completely out of sight, buried in the ground. And far fewer faults occur in an underground system over a period of time than would generally occur in a comparable overhead system. People who use the buildings served by pad mounted transformers are protected from exposed hot lines, and your crews are protected by a door over the primary compartment which lets them work on the secondary without danger from high voltage. Enclosures lock tightly to protect the equipment itself.

Wagner Sub-Urban pad mounted transformers are available in singlephase, 25-167 kva; three-phase 75-750 kva. They require only routine maintenance, and when load growth makes it necessary, larger transformers can be quickly and easily installed to replace original units.

This Wagner Sub-Urban transformer is installed at the Park Ridge, Illinois, executive offices of the Square D Company. It is a 500 kva, three-phase delta-connected, 4160 volt primary transformer.



H. D. Ely, senior staff engineer of a large midwestern utility points to the special HV switching arrangement which permits sectionalizing the primary of a three-phase loop system at the Square D Company.



These transformers serve the Dorcherster Club in Dolton, Illinois. The larger transformer supplies power to refrigerate an indoor skating rink. The smaller unit powers the club's general services and all-electric kitchen.

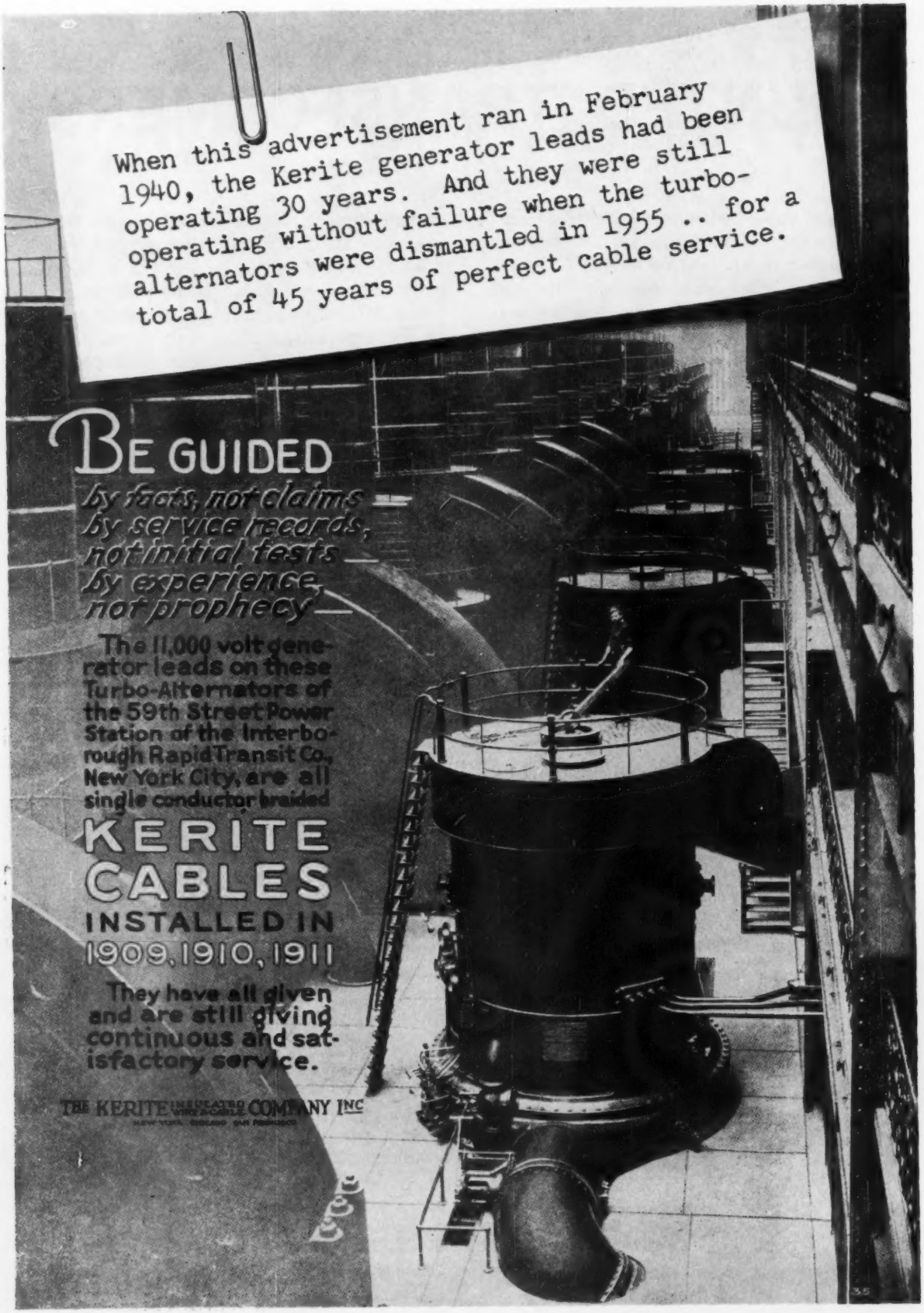
Check with your Wagner Sales Engineer. He's got complete data on Sub-Urban pad mounted transformers... all the facts and figures that prove how easy it is to plan less costly, space-saving transformer installations.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6456 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

When this advertisement ran in February 1940, the Kerite generator leads had been operating 30 years. And they were still operating without failure when the turbo-alternators were dismantled in 1955 .. for a total of 45 years of perfect cable service.


BE GUIDED
by facts, not claims
by service records, not initial tests
by experience, not prophecy
The 11,000 volt generator leads on these Turbo-Alternators of the 59th Street Power Station of the Interborough Rapid Transit Co., New York City, are all single conductor braided
KERITE CABLES
INSTALLED IN 1909, 1910, 1911
They have all given and are still giving continuous and satisfactory service.
THE KERITE INSULATED WIRE & CABLE COMPANY INC
NEW YORK CHICAGO SAN FRANCISCO

These KERITE cables

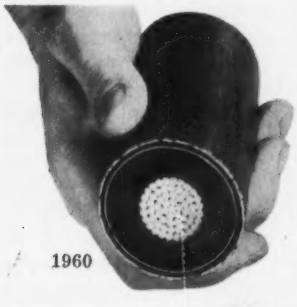
. . . were designed without any of the accurate methods now used to determine conductor size. They were overloaded throughout their lives, and although they were installed in brass pipes and operated at 11,000 volts, they were protected only with a non-conducting cotton braid.

1909

In 1946, one lead was removed, reeled, and shipped to the Kerite factory for investigation.

In spite of 36 years of thermal abuse, almost constant electrical discharge at its surface, and the physical handling involved in its removal and shipment, the minimum 60-cycle A.C. breakdown was above 90 KV with the average 10 KV higher.

Kerite engineers have pioneered improvements in almost every element of generator cable . . . *but the consistently high qualities and long life of the Kerite insulation remain the same.*



1960

THE KERITE CO.
30 Church St.
New York 7, N. Y.
Sales offices in principal cities.

distance it travels from the stricken tower. The charge above the tower, he observed, has a twofold effect:

1. The stroke produces a short rectangular wave on the conductor which attenuates as the distance from the tower increases. The attenuation is so great that by the time the substation is reached, its magnitude may be neglected.

2. The charge above the tower contributes to the voltage across the insulator string at the tower and, to this extent, reduces the necessary voltage that the current must contribute to produce flashover of the insulator string.

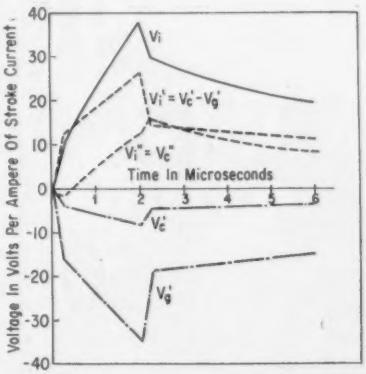
To the extent that current effects are reduced, said Hileman, the steep-fronted voltage waves propagated beyond a second tower are reduced also. Thus, he concluded, it is only necessary to consider the current effects and their distortion by corona between the stricken tower and the substation. This conclusion, he said, is the basis of a simpler method of computation.

Hileman noted that he and his co-author were of the opinion that a proposed short-time test on a breaker should be based on the voltage rate-of-rise at a stricken tower. The paper supplied a table of such rates which, the authors said, should be decreased by some now unknown amount to give realistic results. The rates furnished are a function of distance from the station to the stroke's terminating point.

In the light of their analysis of lightning surge voltages which may impinge on an open breaker, the co-authors proposed that the short-time impulse insulation strength of power circuit breakers be proved by application of a 1½ μsec surge chopped at 2 μsec, whose magnitude equals 1.37 times the breaker BIL.

Wagner and Hileman recommended that a rod gap whose spacing has been coordinated with the breaker BIL be placed on the line side of the breaker. The gap should be just far enough away from the breaker to obviate a 60-cps arc being blown into the bushing.

A new electronically controlled oil circuit recloser was introduced by R. E. Riebs and N. J. Reis, Line Material Industries. Riebs, in presenting the paper, said that the recloser was designed so that its functions are separate and outside the structure housing of the interrupting mechanism.



LIGHTNING STROKE WAVES of negative charge and current produce voltages on ground wire Vg′, phase wire Vc′. Voltage across insulator is Vi′

The functions separated, said Riebs, are the sensing of minimum trip current, time delay, and supply of tripping energy to the contact operating mechanism. Hitherto these were performed by a single mechanism inside the housing. Bushing CTs with the unit are single-ratio and need no adjustment.

Proposals for a new standard for molded-case air circuit breakers and a new interrupting rating for 600-v circuit breakers sparked interest in switchgear sessions.

The proposed standard covers air circuit breakers, either single or multi-pole, assembled as a unit and encased in a supporting housing of molded insulating material. Such equipment has current ratings as high as 800 amp and comes in frame sizes not exceeding that current. Its voltage ratings are up to 600 v ac and/or 250 v dc, interrupting rating exceeding 10,000 amp. In such equipment, overcurrent tripping means may be thermal, magnetic, or a combination of both.

Ratings would include voltage (ac and dc unless otherwise designated), frequency (when required), continuous current at a 25C (77F) ambient temperature, and interrupting current.

The interrupting current rating of a circuit breaker would be given in

(*Continued on page 70*)

NEW SANGAMO STACK RACK CAPACITOR EQUIPMENTS

put more kilovars in less space

Here's the newest Sangamo development in capacitor stacking units . . . designed around the smaller and lighter Sangamo 50 kvar and 100 kvar capacitors. You get more kilovars in a given amount of space. For example, the new Sangamo stacking units with 100 kvar capacitors provide twice as many kvar as previous equipments, yet have the same length and height dimensions, and are only 12 inches wider.

There's a big weight reduction, too. Equipment weights with 50 kvar units are down 20 percent or more—those with 100 kvar units, down 25 percent or more.

You'll save money, time, and substation space by stacking your kilovars with Sangamo stacking units. Compact and light, they permit better use of premium space, require minimum footing, and are easier to mount. Need less maintenance, too, because of stainless steel capacitor cases, all-welded aluminum rack construction, high structural strength, and non-ferrous fittings.

Remember, Sangamo equipments with 100 kvar units make it possible to use one rack where two were formerly required. This is especially important in 3-phase packaged substation equipments, and in some instances on large, high voltage stack rack installations.

Write us for further information.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

PC61-2

AIEE GENERAL MEETING

(*Continued from page* 69)

amperes (rms if ac) at a given voltage rating and should indicate whether symmetrical or asymmetrical. This rating would be based on the test procedure included in the standard proposed, applicable operating study or duty cycle, performance, and conditions in the test procedure. The dielectric test voltage would be 1,000 v, plus twice the rated voltage of the breaker, applied continuously for 60 sec. But at the manufacturer's option, the breaker may be tested for 1 sec with a voltage 20% higher than that specified for the 60-sec test.

Calibration setting of time delay trips would be based on an ambient temperature of 25C ± 3C (room temperature), and the breaker would be required to carry continuously a current equal to its continous current rating in an ambient of 25C ± 3C.

H. I. Stanback, Square D, told conferees that selection under the new standards would generally fall on a breaker of the same size but occasionally on a smaller one for the same circuit, as in the older procedure. All that has been changed, he noted, is the approach to the problem, and the result has been a more simplified application.

Using the new symmetrical ratings, an application engineer now selects the protective devices for a system on the basis of these choices. Having determined by calculation or measurement the properties of the system, he selects equipment rated to satisfy those properties. His selection is in accordance with application instructions coordinated with the ratings. How well such equipment performs is governed by the accuracy of the application and the thoroughness of the test codes for verifying ratings.

A new 4,160-v metal-clad switchgear was introduced by W. A. Carter, A. Conangla, and J. E. Nugent, the last acting as spokesman in describing this I-T-E Circuit Breaker Co development.

Nugent pointed out that the new breaker's characteristics comply with the proposed switchgear standard, and especially in increased insulation, higher interrupting capability, high-speed stored-energy closing, racking to test and disconnected

positions with the front panel closed, safer operation, and simpler installation, inspection, and maintenance.

This new 5-kv metal-clad switchgear, said Nugent, has flame-retardant and non-tracking materials molded to shape in the breaker and its stationary structure. It also has "face-wound" magnetic blowout coils, cutting down on the bulk of the interrupters, and the interrupters themselves have greatly improved performance on both symmetrical and asymmetrical currents.

HV Fuse Available

F. L. Cameron, Westinghouse, described a new fuse developed to meet high-voltage motor-starting requirements. The fuse, he said, interrupts minimum, maximum, and intermediate range fault currents without noise or display, and its total clearing time for maximum fault currents is much shorter than those of older fuses. The fuse, he said, is also fatigue proof against the element damage associated with heavy motor-starting current fluctuations.

A study of the mechanical behavior of a dead tank OCB during a high-power short-circuit current interruption was reported by P. Wildi, in behalf of himself and co-author M. G. Mathers, both of Federal Pacific Electric Co. Their experiments were made on 115, 138, and 230-kv OCB's and produced the authors' hypothesis.

According to Wildi and Mathers, dead tank OCB bushings are subjected to tension and cantilever forces caused by vertical acceleration during short-circuit interruption. This vertical acceleration, he said, merits some consideration in the designing of OCB's.

The Stanford Research Institute, under contract to the Lawrence Radiation Laboratory, developed a mechanical crowbar-type, high-capacity switch for special experiments.

This switch, according to Peter M. Newgard of the Institute, is a roller-contact type which proved capable of conducting at least 18,000 amp. It has a contact resistance of about 5 micro-ohms, resulting in a 0.1-v voltage drop and a power dissipation of 2,000 w during the conduction period. Mechanical re-

(*Continued on page 72*)

SANGAMO POLE-TYPE CAPACITOR EQUIPMENTS

Now, Sangamo pole-type capacitor equipments let you pack more kilovars into existing pole space. These new, all-welded aluminum rack equipments are more compact and weigh less because they are designed around Sangamo's smaller and lighter 50 kvar and 100 kvar capacitors. For example, the length of a 12-unit, 600 kvar rack with 50 kvar units has been cut by two feet, while its weight has been reduced by 20 percent over previous models. Still greater weight and length improvement is obtained with 100 kvar units. Reduced length and lower weight minimize both twisting and bending moment—make installation easier and lower in cost.

Sangamo pole-type equipments are available as both in-line and cluster mounts. Standard equipments with 50 kvar capacitors can carry up to 900 kvar in both types. Standard equipments with 100 kvar capacitors can carry up to 1200 kvar with the in-line rack; up to 1800 kvar with the cluster mount.

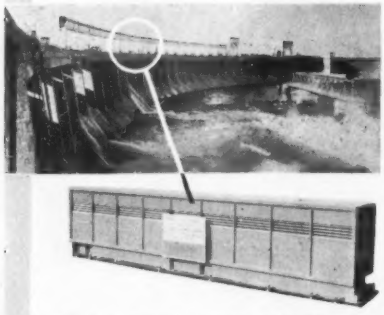
The in-line type has front-of-pole bracing to provide maximum climbing space free of grounds. 5 KV insulated stranded cable is used for unit and switch connections. Unswitched equipments have provisions for future addition of switches. All-welded aluminum racks, non-ferrous hardware and stainless steel capacitor cases keep maintenance costs down.

Write us for further information.

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

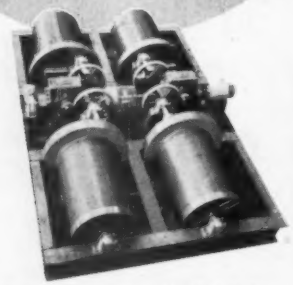
PC61-1



For the second largest hydroelectric power plant in the United States at Massena, New York—as part of the St. Lawrence power project—Uhl, Hall & Rich, project engineers, selected MURCO Gate Hoists to control the water level at Long Sault Dam. Each hoist weighs 93,000 lbs. . . . overall length 57 feet, 8½ feet wide, 12½ feet high . . . lifting capacity of 175 tons and will raise and lower the gates in a dam at a speed of 1 foot per minute.

Murco GATE HOISTS

MURCO Gate Hoists are designed and made for any size power dam . . . capacities from less than 1 ton to over 375 tons . . . from the smallest hand operated to the largest motor operated hoist, all made to specifications.



One of the two 380-ton MURCO Gate Hoists furnished to the Power Authority of the State of New York.

Each hoist operates a gate 46' wide by 67' high at one foot per minute. These gates divert the water from the Niagara River above the Falls into covered conduits five miles long. The two conduits bring the water to the Niagara Generating Plant on the United States side of the Falls.

Write for complete information . . . Engineering Department recommendations . . . when you are planning power dam projects.

D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883
WAUSAU, WISCONSIN

AIEE GENERAL MEETING

(*Continued from page* 71)

peatability is obtained through a pneumatic actuator.

A. H. Sharbaugh, T. H. Lee, and Allan Greenwood described, each in part, a General Electric Co study of the breakdown strength of nitrogen at high temperatures in a shock tube. Their findings, according to the authors, will probably prove useful for conditions to be met in the operation of air blast breakers.

Greenwood, in summarizing, noted that earlier investigations showed that Paschen's Law holds up to temperatures above 1,000K, but that sufficiently high temperatures produce variations in the behavior pattern of the gas, the degree of thermal ionization increasing significantly. These departures, he said, occur around 2,000K.

At 4,000K a breakdown voltage as low as 50% of that predicted by Paschen's Law was observed even before the attainment of equilibrium ionization.

Existing Safety Standards Need New Revisions

Discussions on the lack of universal electrical engineering safety standards and the inadequacy of existing electrical safety practices applicable to higher voltage electrical systems in industrial and commercial buildings sparked the safety planning sessions.

The electrical industry for many years has had safety standards for equipment and installation, and additional local safety rules have been drawn up at different times by individual utilities and users of electrical equipment. However, no general universal set of safety standards has yet been adopted. "Sound electrical engineering safety standards should take their place alongside accepted standards for equipment and installation practices," J. W. St. Andre, Kaiser, pointed out.

While it was generally agreed that electrical equipment is manufactured with safe operation in mind, in actual use this same equipment often is required to handle current and voltage beyond that for which it was designed—generally because the operator is insufficiently

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Director, Research and Development Day-Brite Lighting, Inc.

Here is help in acquiring a practical understanding of fluorescent lighting that points to more effective installations and maximum satisfaction of use. This down-to-earth volume brings you authoritative working information on the design, construction, and performance characteristics of fluorescent lamps. It presents the principles and procedures necessary for calculating illuminating requirements . . . covers the design of luminaries and auxiliary equipment . . . details practical methods for use in maintaining and repairing all parts of any fluorescent lighting system. The book also provides a full treatment of the economics of lighting—including a comparison of the cost factors of fluorescent and incandescent lamps. This fully revised edition of a highly successful manual brings you abreast of major developments—enables you to insure top efficiency and economy in fluorescent lighting. **3rd Ed., 393 pp., 232 illus., $12.50**

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Explains the many economic and technical factors involved in electric utility rate making . . . covers cost analysis, depreciation, and more. **By R. Caywood, West Penn Power Co., 248 pp., $10.00**

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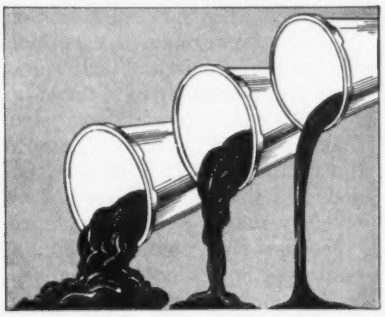

Minerallac gives you a complete assortment for every need: dense, viscous and fluid consistencies for high and low voltages in cable-joints, pot-heads, terminal bells, distribution cables, street lighting, telephone work . . . Insoluble in oil or water, for all temperatures. Clean, safe, economical—outranks all others in quality.

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. . . For Locating Faults in Lead-Covered Cable . . . For D-C Proof Testing

BIDDLE CABLE FAULT LOCATING EQUIPMENT

Has applications on aerial, or buried cable, as well as on lead-covered cable installed in ducts. Equipment combines a high-voltage capacitor discharge transmitter with a detector to form a complete Tracer Current Set. Provides high current and voltage output with small energy input. Equipment is moderate in size, weight and cost. Use is not restricted by networks or branches, and under certain conditions will even operate successfully without disconnecting transformers. Method of detection indicates whether fault has been reached or passed when an exploring pick-up coil is applied at various points along the cable.

Biddle Model's	Output Voltage	Discharge Capacitance
Catalog 651125	Up to 25 KV	1.65 muf
Catalog 651015	Up to 15 KV	2 muf
Catalog 651005	Up to 5 KV	16 muf

B-1005 **Write for Bulletin 65-W**

JAMES G. BIDDLE CO.
Electrical and Speed Measuring Equipment
1316 Arch Street, Philadelphia 7, Pa.

trained in use of the equipment.

Load center distribution systems, ranging from 2.4 kv to 14 kv, have in recent years been used extensively in industrial buildings. Even under conditions where safety training staffs are available, extra care is required in equipment selection.

Of alarming concern is the problem in commercial buildings. Because of increased lighting demands and air conditioning loads, medium voltage load center distribution systems are now frequently used in large commercial buildings, hospitals, and schools, yet these buildings lack the operating and maintenance staffs qualified to operate and maintain electrical equipment for 600 v, much less higher voltages.

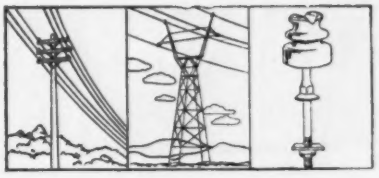
The Task Force on Medium Voltage Systems of the AIEE Industrial and Commercial Power Systems Committee commented "The question arises whether the National Electrical Code rules for the installation and equipment over 600 v are adequate under the existing conditions."

As a first-step means to bridge the gap of inadequacy the task force prepared and presented to the safety symposium a preliminary report, "Guide for the Installation in Buildings of Wiring and Equipment Over 600 V."

While the guide certainly does not attempt to resolve totally the hazardous circumstances, it does point out in clear terms: (1) the need for vigorous safety action in commercial electrical systems exceeding 600 v; and, (2) interim safety precautions which should immediately be achieved.

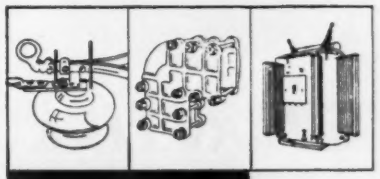
4-KV SWITCHGEAR for hospital supply is nearly obscured by equipment

(*More AIEE on page 74*)

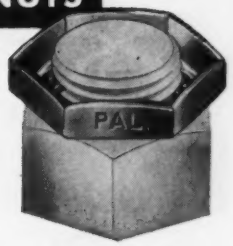


Keep Nuts Tight

on all bolted assemblies



Apply
PALNUT LOCK NUTS

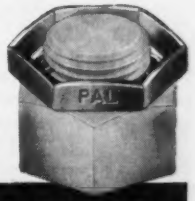


PALNUT Lock Nuts apply so fast, lock so dependably . . . you can specify them for every nut-and-bolt assembly, at negligible cost. Maintenance is reduced on mechanical assemblies—full conductivity assured on electrical connections.

PALNUT Lock Nuts may be used on new or existing equipment. Easily removed and re-used when servicing. Require only 3 bolt threads. Available in plain, Parkerized and hot dip galvanized steel; also silicon bronze.

Send for free samples, stating size and application

THE PALNUT COMPANY
Division of United-Carr Fastener Corp.
51 Glen Road
Mountainside, N. J.



PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost

EXTRA Holding Power
QUICKLY Installed
TOUGH For long life

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ANCHORS

For new construction and maintenance — Everstick Anchors speed up work and provide dependable anchorage on all types of jobs. Made of resiliant, rust resistant malleable iron. The toughest anchors made. Write for bulletin.

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NATION'S
LARGEST
FEDERAL SAVINGS
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pays you 4½% on savings

DIVIDENDS PAID QUARTERLY at 4½% current annual rate • World headquarters for savings of 160,000 individuals, corporations, and trusts in 50 states, 71 foreign countries • Same, sound management policies since 1925 • $38,000,000 reserves • Resources: $600,000,000 • Accounts insured by Federal Savings & Loan Insurance Corp. • Man and wife can have up to $30,000 insured • Funds received by 10th, earn from 1st • We pay air mail both ways

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FREE FINANCIAL GUIDE: "The California Story" contains experts' ideas on saving money, investing in homes, insurance, stocks. Other exciting features!

E-1

California Federal Savings & Loan Assn.
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Please send free "The California Story" and Cal Fed MAIL-SAVER to:

Name _____

Address _____

City _____ Zone _____ State _____

☐ Funds enclosed in amount of $ _____

AIEE GENERAL MEETING (*Continued from page 73*)

Automatic Reclosing Successful

Automatic reclosing on a bus has been 100% successful in a 138-kv metropolitan substation which has a fault duty of 2 million kva, R. A. Larner, Texas Electric Service said. He concluded that automatic reclosing on buses is desirable but may be limited by fault current.

W. E. Marter, Duquesne Light Co, however, felt that it is necessary to establish and compare the advantages and hazards of reclosing. Quick restoration of the bus must be balanced against explosions, fire and scattering of porcelain. He concluded that bus reclosing is not justified on his compact system which has high fault currents with loop feed to almost all substations.

Automatic reclosing was built into the AEP System design and is a part of all bus differential protective schemes from 4 to 345 kv, A. Hauspurg reported. Records show an average of one bus fault per bus every 15 years with 70% successful reclosure.

C. J. Cregar, Georgia Power, reported 35% successful reclosures at unattended substations. J. R. Linder emphasized that automatic reclosing of buses was another step in the increasing automation of power systems.

Dual Tones Cut False Tripping

Experience with microwave relaying indicates that dual tone channels practically eliminated false trippings, said T. W. Springfield, H. S. Lorentson, and R. E. Dietrich of BPA. Employing pulse time division equipment in the direct underreaching scheme, practically complete immunity to false trippings was experienced with dual channel operation.

In discussion, E. W. Downer, Cleveland Electric Illuminating, suggested that the number of false trip signals was excessive when compared with his company. For instance, one channel alone produced 3,000 false tripping signals in three months. But he agreed that the direct underreaching scheme has merit for multi-terminal lines because of the absence of fault detector contacts at the receiving end, while stressing that this scheme requires two channels for security and testing.

Switching surges become a primary consideration in insulation coordination when reduced insulation levels are used, reported a working committee. Among the conclusions in its progress report were these:

- Surge voltage on bus, line, cable or apparatus can be a damped transient, single or repeated at random and sometimes superposed on 60-cps voltage; a transient superposed on ferro-non-linear oscillations; sustained linear oscillations; or sustained nonlinear oscillations.
- De-energizing lines, cables or capacitor banks can, with one restrike, produce a transient crest of 2.5 to 3.0 times normal line-to-neutral crest voltage, at a natural frequency of 114 to 1,443 cps in 346 to 4,400 μsec.
- Transformers connected to a line reduce the probability of breaker restrike but may add ferro-non-linear oscillations to the transient to cause arrester operation.
- Very-high-frequency overvoltages caused by operating a bus disconnect can peak in several μsec to cause arrester operations severe in duty because of prolonged repetition.
- Energizing a line with a transformer at the receiving end can operate receiving end arresters.
- Rapid reclosing on a line with trapped charge can produce more severe surges than normal reclosing; lines left shunted by transformers lose their charge in a few cycles.
- Switching a faulted line can inpose transients of 2.8 times normal voltage on unfaulted phases, even with no restrikes.
- Interrupting small inductive currents (10 to 30 amp) can spark over arresters with transient voltage from current chopping, but modern core steels in transformers usually hold transient voltages from this cause below twice normal.
- Dropping load from a receiving-end transformer can cause harmonically-distorted overvoltages, predominantly 5th harmonic on short lines and 2nd harmonic on longer ones.

PROFESSIONAL SERVICES

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction
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LINE CONSTRUCTION CORP.
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Portable electric test equipment
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For low voltage testing and calibrating of circuit breakers, protective and overload relays, reclosers, watt hour meters, fuse links.
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Public Utilities—Industrials
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WHO'S WHO in—
Electrical Equipment Representatives
Write for free copy of EERA Directory
C. W. SWARD, Executive Director EERA
1675 Fifth St. Clermont, Florida

LARGE POWER EQUIPMENT
Prompt Stock Shipment
RENUBILT MOTORS - GENERATORS
TRANSFORMERS - CIRCUIT BREAKERS
DO YOU GET OUR STOCK LIST?
BELYEA COMPANY, INC.
51 Howell St. Jersey City, N. J.
OL-3-3334

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5522) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, April 11, 1961, for furnishing, installing and testing eight (8) 125,000-kva, 90 percent power factor, 13,800-volt, 150-rpm, vertical shaft, hydraulic-turbine-driven generators for Glen Canyon Powerplant, Colorado River Storage Project, Arizona-Utah. Complete installation required within 930 days 1st unit; others at 120-day intervals. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner.

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5518) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, March 23, 1961, for furnishing main control and graphic boards for Clear Creek, Trinity, and Spring Creek Powerplants and unmounted equipment for Keswick Powerplant, Central Valley Project, California. Delivery is desired within 180 to 540 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner.

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5529) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, April 4, 1961, for furnishing duplex main control boards for Creston, Denison and Spencer Substations (Stages 01) for Missouri-Oahe Transmission Division, Missouri River Basin Project. Delivery is desired within 270 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner.

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information and more products or better service—more value— to YOU.

ELECTRIC UTILITY SALESMEN

Thomas & Betts, a leading manufacturer of electrical fittings and a pioneer in the development of electric utility accessories, has immediate openings for AMBITIOUS MEN in its expanding Utility division.

Positions require 1 to 5 years' sales experience in the Utility field, an EE or ME Degree or equivalent with an understanding of transmission and distribution practices and equipment.

We offer excellent earnings potential, salary plus commission, and unlimited opportunity to advance in a growth Company.

Applicants are invited to send resume with complete details and salary expectation to:

Personnel Manager
The Thomas & Betts Co.
36 Butler Street
Elizabeth, New Jersey

T&B ENGINEERED **THOMAS & BETTS**

ADDRESS BOX NO. REPLIES TO: Box No.
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Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

POSITIONS VACANT

Electrical Engineer familiar with electric power systems. Permanent employment with opportunity for advancement in long-established consulting engineering firm. Write or call Stanley Engineering Company, Muscatine, Iowa.

Construction Supervision. Construction Engineer for inspection and supervisory work on electric power lines and substations. Opportunity for permanent employment and advancement with well-known consulting engineering firm. Send resume to P-6001, Electrical World.

Electrical Engineer—Excellent opportunity for graduate engineer to enter consulting field and grow with progressive Midwest concern. Board layout work—power, lighting, and control systems; calculations; and occasional field contacts. 3-5 years experience. Moving expenses paid. Send resume, including education, experience, and personal qualifications to P-6246, Electrical World.

POSITION WANTED

Distribution Engineer or Superintendent with Electrical Utility; 35 years of age, 2 years college, ICS Electrical Engineering courses, 14 years utility experience in distribution, transmission, metering, and street lighting. PW-6256, Electrical World.

DON'T FORGET

the box number when answering advertisements. It is the only way we can identify the advertiser to whom you are writing.

Udall States Interior Policy

Following is the text of a letter sent to Interior Department employees by Sec Stewart Udall.

America's future depends upon its ability to successfully meet the challenges of today and tomorrow—the problems at home . . .

. . . The Department of the Interior is charged with grave responsibilities by law and executive direction in vigorously carrying out programs and implementing policies that bear directly on the economic and social strength of our nation. Each of us in some degree shares in this total responsibility.

The Department of the Interior is committed to the full development and maximum utilization of the natural resources of the country. I am confident that we will have the energetic support of employees of the Department in furthering this objective. We need the cooperation of other governmental bodies and agencies and of the many public and private organizations, as well as individuals who are concerned with our natural resources.

The electric power aspects of the Department's programs represent one of its most vital activities. The furnishing of an adequate supply of low-cost power for the homes, farms and industry sufficient to service a dynamic economy is a matter of basic importance to the economic growth and defense of the nation and is, therefore, a matter of governmental concern. Utility systems of all kinds—federal, state, private, cooperative—must carry out their full responsibilities to the public welfare.

In the development of power policies of the department, we will be guided by the policies enunciated by President Kennedy and set forth in the appropriate acts of Congress. In 1946 the Department expressed the basic principles embraced in the acts of Congress dealing with the government's power development activities as follows:

1. Federal dams shall, where feasible, include facilities for generating electrical energy.

2. Preference in power sales shall be given to public agencies and cooperatives.

3. Power disposal shall be for the particular benefit of domestic and rural consumers.

4. Power shall be sold at the lowest possible rates consistent with sound business principles.

5. Power disposal shall be such as to encourage widespread use and to prevent monopolization.

These fundamental principles form the foundation upon which we will build a sound power program for the future.

The power agencies of the department will exercise vigorous leadership to insure that the marketing of federal power will produce maximum benefits for the people of each area. Among other things, this will require increased coordination of planning by the Department with customers given preference under law by the Congress and other utilities.

I have directed Assistant Secretary Holum to take those measures necessary to encourage this leadership.

I am also directing that immediate attention be given to:

1. Determining the proper role of each agency in its area;

2. Expanding the planning activities of the Department to make possible the timely construction and full development of new projects and facilities;

3. Achieving the maximum practicable amounts of firm power for the ultimate user from federal power systems;

4. Enlarging regional cooperative pooling of generation and transmission facilities; and

5. Planning for the early interconnection of areas served by the Department of the Interior marketing agencies with adequate common-carrier transmission lines.

Every aspect of our democratic society is being tested today as never before in history. The challenge to us is a total one, calling for total action by a free people. As President Kennedy so aptly said: "To meet these challenges we must be strong—we must summon all our resources—resources of mind and spirit, and the resources which lie beneath our earth, and in our mountains and in our rivers—those resources on which we have built a great nation—those resources on which her continued greatness depends."

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Strandvise® alone

has these straight-down-the-line abilities

FEED-THRU *ability*

Nothing approaches the value and ease of the feed-thru mechanical chuck for placing and tensioning a guy. Use no tensioning tools until after the guy is in place. Then each click of the hoist feeds strand thru the chuck to desired tension.

ONE-MAN *ability*

A one man "crew" can complete a down guy easier, faster and safer than with any other method. Strandvise is a "natural" even for EHS strand.

USE *ability*

No precision pre-cutting. No markers to locate and line up. No size color codes to remember.

NO-CORRODE *ability*

External—Tube and yoke are each a homogeneous aluminum alloy. There is no coating . . . scratching or abrasion cannot initiate corrosion.

Internal—Both laboratory tests and field service exposure (natural cycling) have repeatedly failed to show evidence of corrosive attack on strand within the gripping area. Tapers and initial tension wedge and seal that area.

RE-USE *ability*

Strandvise is wholly reusable; once, twice, or a dozen times.

ADJUST *ability*

Luck plays no part during the tensioning operation. Strandvise "swallows" strand with each click of the hoist—Tension is a fact.

NO-ABRASION *ability*

The stainless steel bail has no peers. There is no coating to abrade away. 18-8 stainless steel will never rust or deteriorate in any known corrosive atmosphere.

REACH *ability*

The overall length of Strandvise averages less than 12 inches for most sizes.

SAFE *ability*

No need to remove come-along or hoist to gain working space before the job is completed. With Strandvise the load is always captive.

NATURAL *ability*

Nothing to study—nothing to avoid—nothing to ("look-out!") for—wholly safe to install without safety glasses and gloves (where regulations permit).

NO-FOUL-UP *ability*

The only wire is the guy wire. The only ingenuity called for is already built into Strandvise.

PROCEDURE *ability*

Give or take guess work is no part of Strandvise—nothing to get ready, nothing to allow for. (Stainless bail cannot stretch.)

MULTIPLE GUY *ability*

Double and triple guying to one guy rod presents no working space problems with Strandvise.

TAMPER-PROOF *ability*

Mischievous release is impossible unless the "villain" has a hoist and come-along.

COST *ability*

You can use every Strandvise you buy . . . none are rendered useless by storage or handling damage, or by field mistakes.

Installed costs favor Strandvise all the way. One man for five minutes is all the "help" Strandvise needs for a *completed* down guy.

HOLDING *ability*

Forged and case hardened chucks are quality controlled at factory and are consistent by nature of design and tooling. No grit or combination of coatings to be controlled and trusted.

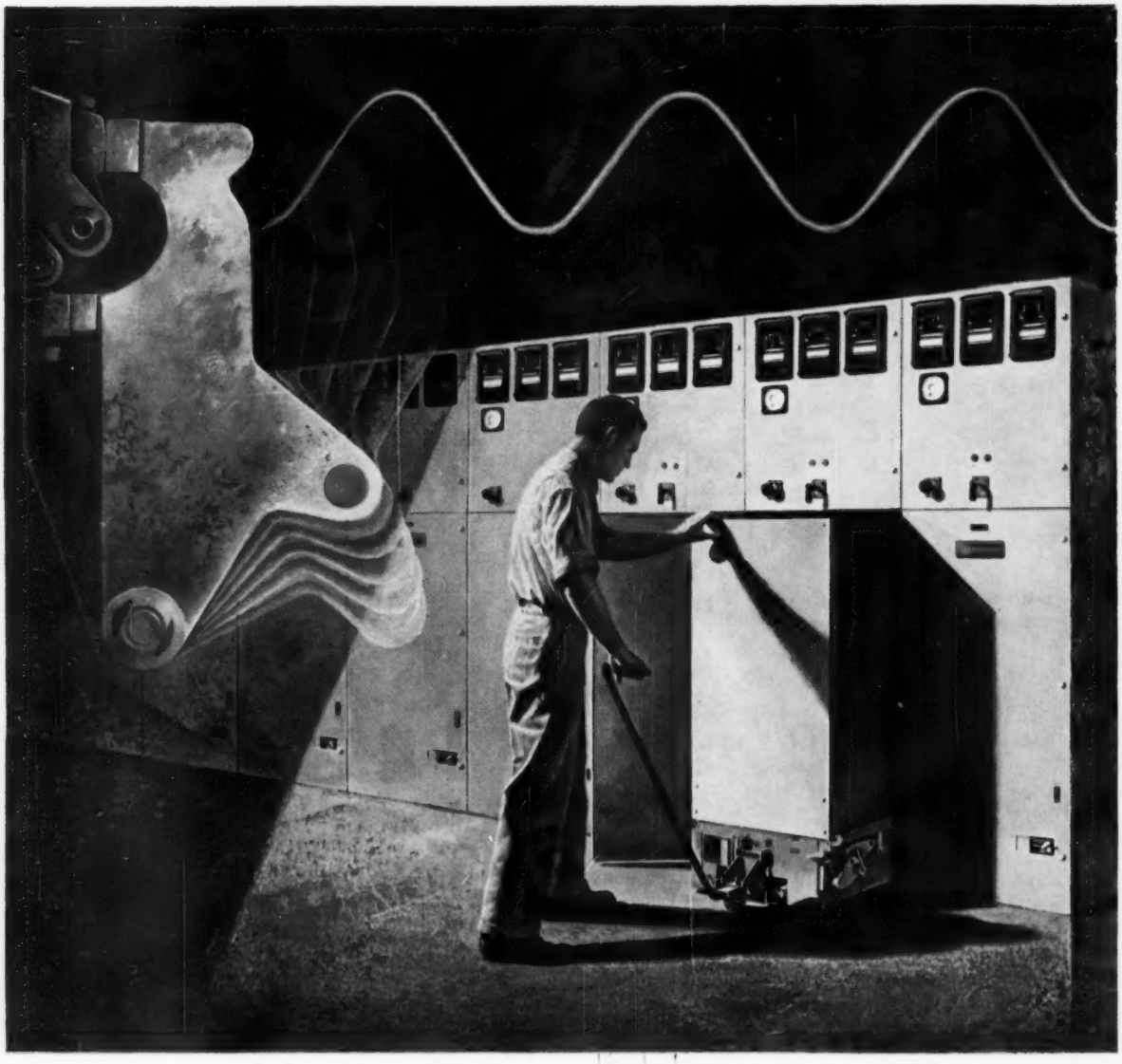
During 27 years of continuing production, it has never been reported that a Reliable Feed-Thru Deadend Chuck let go a line. (Strandvise is in its twelfth year of production.)

Reliable

A Symbol of Integrity Since 1909

RELIABLE ELECTRIC COMPANY

Franklin Park, Illinois



OF COURSE YOU WANT STORED ENERGY. GET COMPACTNESS TOO

Why use more space than you have to for metal-clad switchgear. The new compact I-T-E line fits where other makes simply can't go — both 4.16 kv and 13.8 kv classes. This gear is completely redesigned, not just modified.

Stored energy closing, of course, is standard. This means longer contact life, plus more dependable operation, and the low current charging motor means lower operating power cost. Breakers can be drawn out without opening doors. This means new safety. The instrument compartment is completely isolated and has its own door. Secondary wiring is more accessible than ever and safer than ever.

Throughout this equipment, abundant use is made of new modern materials for lighter weight, greater strength, easier upkeep. This, truly, is today's most advanced metal-clad switchgear. Write for Bulletin 2800-2B. I-T-E Circuit Breaker Company, Dept, SW, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY